GAS

NOVEMBER 1961

Distribution maintenance

A CHILTON PUBLICATION

THE NATION'S NATURAL GAS AUTHORITY

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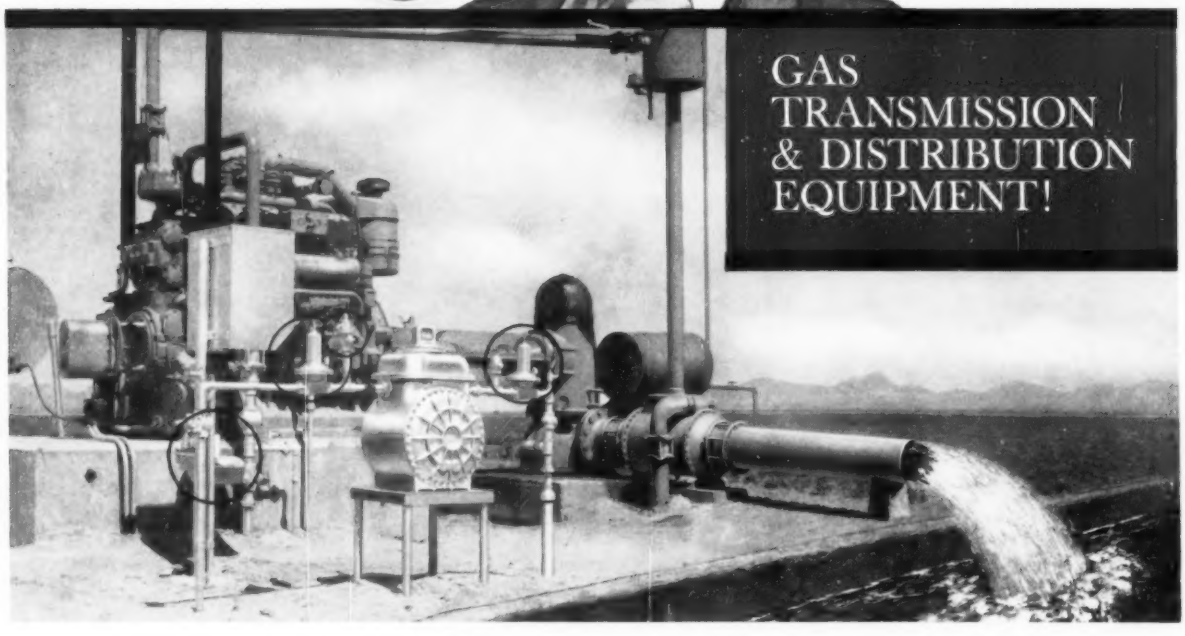

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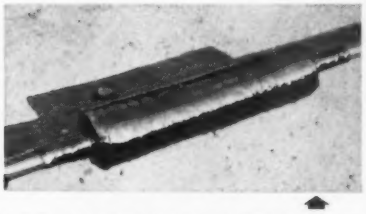

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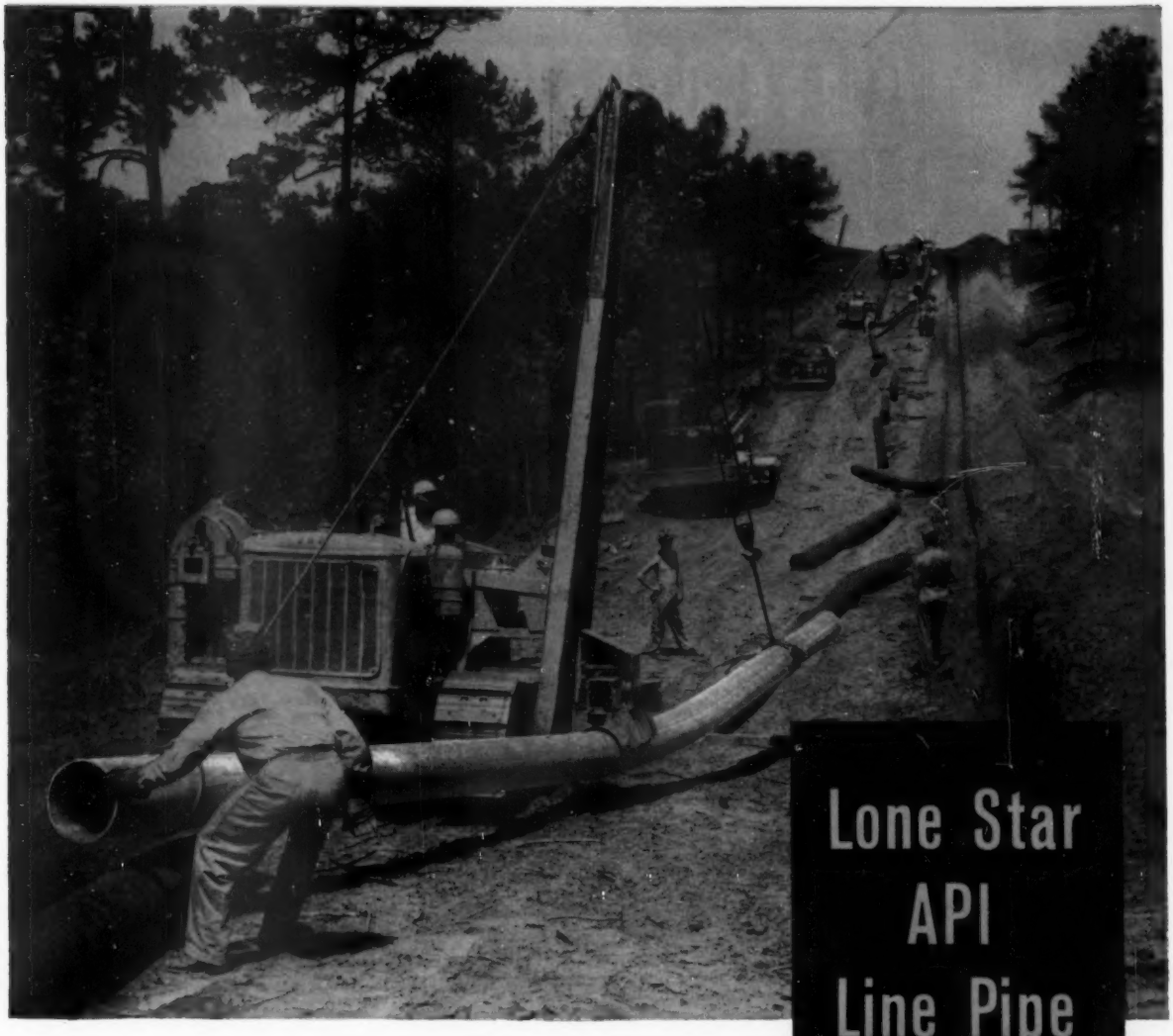

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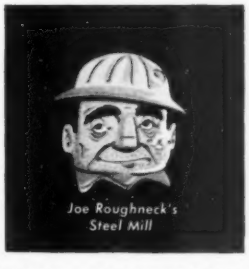

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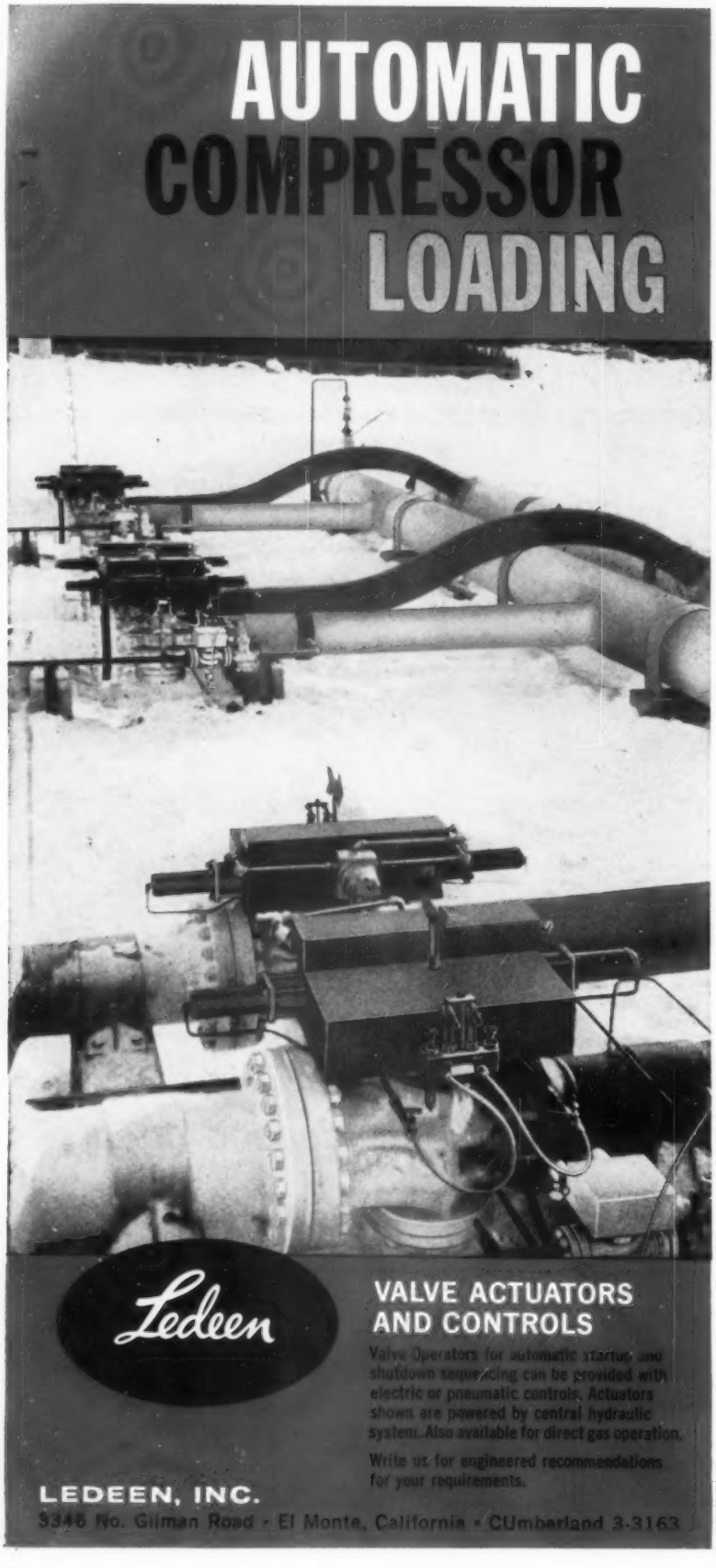
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BPA NBP

CALENDAR

November

13-15. American Petroleum Institute Annual Meeting—Chicago.

December

4-5. Florida Natural Gas Association Annual Sales Conference—Sarasota, Fla.

1962

February

14-16. AGA Home Service Workshop—Milwaukee Inn, Milwaukee.

March

18-22. National Association of Corrosion Engineers—Municipal Auditorium, Kansas City, Mo.

22-23. New England Gas Association Annual Meeting—Statler Hilton, Boston.

26-28. AGA General Management Section Annual Conference—Denver Hilton Hotel, Denver.

April

2-5. AGA Operating Section Distribution Conference—San Francisco.

9-10. Mid-West Gas Association Annual Meeting—Hotel Radisson, Minneapolis.

10-12. AGA Sales Conference on Industrial & Commercial Gas—Shoreham Hotel, Washington, D. C.

17-19. Southwestern Gas Measurement Short Course—University of Oklahoma, North Campus, Norman.

23-25. GAMA Annual Meeting—The Greenbrier, White Sulphur Springs, W. Va.

30-May 2. Joint AGA Transmission Conference and Southern Gas Association Annual Convention—Houston.

May

21-23. AGA Mid-West Regional Gas Sales Conference—Edgewater Beach Hotel, Chicago.

25-26. Florida Natural Gas Association Annual Convention—Robert Meyer Hotel, Jacksonville, Fla.

June

4-5. AGA Operation Section Production Conference—Statler Hilton Hotel, Boston.

20-23. Canadian Gas Association Annual Meeting—Manoir Richelieu, Murray Bay, Quebec, Canada.

25-26. Michigan Gas Association Annual Meeting—Grand Hotel, Mackinac Island, Mich.

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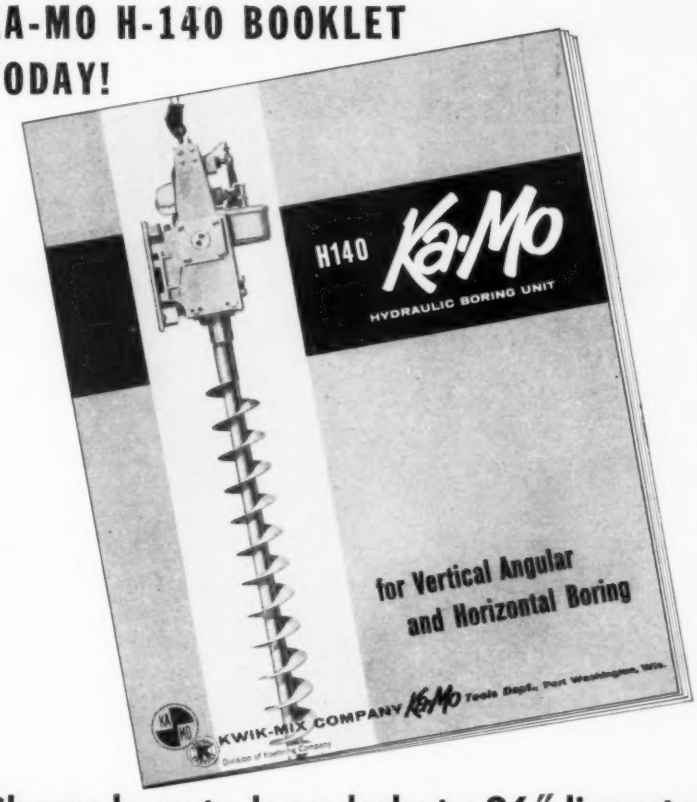
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GAS

NOVEMBER 1961

Thermally Thinking

A look at reserves Ala' Texas

COLD winds and snow are causing some activity down here in Texas, where this is being written this month. I don't have the exact count as of this minute, but on Jan. 1, 1961, there were more than 18,000 producing gas wells and almost 130,000 producing oil wells reporting casinghead gas production in Texas. Whatever the change in this count is, we hope it's up. For the wells are "working."

These wells in the Lone Star State are producing natural gas pipelined to nearly all parts of the country from border to border, and from coast to coast.

AGA statistics estimate that there was a proved reserve of 264 trillion cu ft of natural gas in the U. S. on Jan. 1, this year. Fully 119.5 trillion cu ft of this reposed in reservoirs in Texas. (For the measurement folks, all volumes are stated at 14.65 psia and 60 deg. F.) Thus, the great State of Texas holds some 45 per cent of the national natural gas proved reserve.

Production-wise, ole' Texas does pretty well, too. In 1960, net gas production in the state amounted to 5.903 trillion. This figures out at about 45 per cent of the total net natural gas production for the entire U. S.! Texas' marketed natural gas had a value of $692 million last year. Add to this $412 million yielded from liquids extracted from natural gas, and Texas had a $1.104 billion natural-gas year in 1960.

According to one of the best petroleum and natural gas consultants in the business, Ralph E. Davis of Houston, uncommitted gas reserves in Texas are pretty scarce. By "uncommitted reserves" we mean only gas-well-gas currently available to market and not now under contract. This term excludes: (1) relatively small volumes of casinghead gas being flared or popped to the atmosphere; (2) reserves in cycling projects where gas is being produced, stripped of its NGL, and returned to reservoir to be produced to market at some later date; (3) shut-in gas caps; and (4) gas used in large repressuring projects—natural gas being the most important medium for producing oil and increasing its recovery in Texas. But, while Ralph Davis' intensive study shows uncommitted reserves in Texas at only 1.64 trillion cut ft, after field use and shrinkage, you really wouldn't expect that all these gas pipeline companies in the area would let a whole lot sit around. They line it up pretty fast. These pipelines have substantial gas reserves in Texas under contract and commitment, although this gas is not necessarily entirely dedicated to the pipelines' present connections.

There is a reserve of at least 10 trillion cu ft here in Texas that is both uncommitted and presently unavailable. This is gas sitting in shut-in gas caps, or used for repressuring or cycling operations. These reserves will become available for market at varying times in the future. Again we are indebted to the widely known and respected Ralph Davis for these data. My friend Mr. Davis has expressed the opinion that the present heavy demand placed on Texas gas reserves by both interstate and intrastate commerce can be met for a period in excess of 20 years.

The "present heavy demand" on Texas gas production will probably become an "increasingly heavy demand" in the future. Larry Shomaker and the AGA Committee on Gas Requirements and Supply will, we hope, produce something valid to work with in this respect. The question is, will Texas be able to come up with the reserves to match the increasing demand on its production?

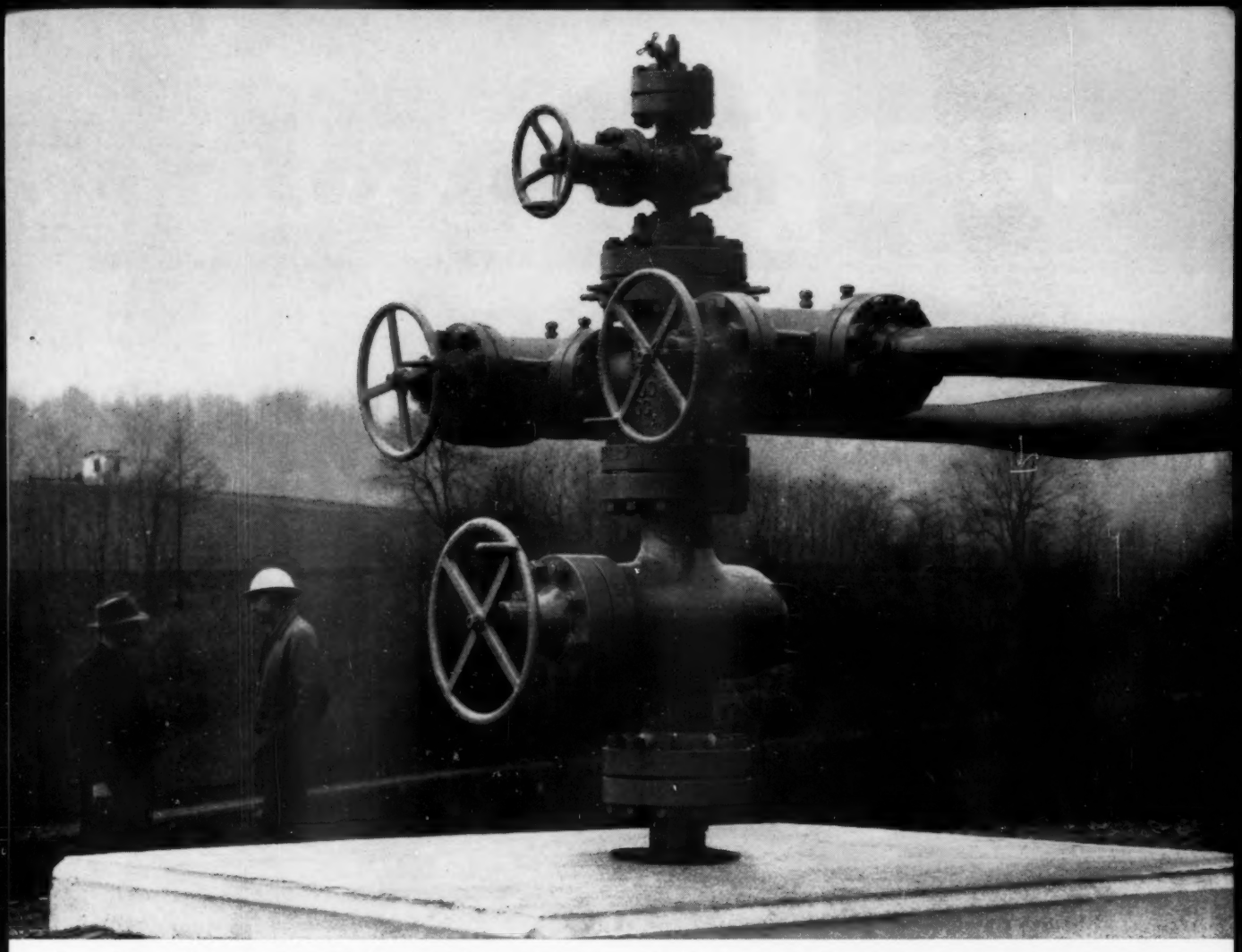
Looking at the history of all hydrocarbon exploration, we must conclude that the more obvious, easy-to-find traps are first discovered. Successive discoveries involve deeper drilling. This means more cost. The greater amount of searching necessary at depth results in more leases, higher exploration and land costs, and a lower strike rate—resulting in an increased cost for maintaining a gas supply.

Like Ralph Davis says, "Obviously, natural gas is where you find it. In the future it will be found where you can afford to look for it."

Will they be able to afford to look for it down here in this vast oil and natural gas province of Texas? I think they will, but only if these factors become reality; (1) a favorable economic climate, (2) equitable and swift regulation, (3) fair price, and (4) reasonable taxation.

J. Ford Eldan

EDITOR



Terra Alta field is being developed by the Atlantic Seaboard Corporation in West Virginia. Total ultimate capacity will be 33 billion cubic feet of natural gas. On this wellhead, pressure will be up to 2,000 pounds. Well depth is about 5,300 feet.

How to get complete gas storage well control with standard National wellheads

This National Supply wellhead is installed in the Terra Alta natural gas storage field, owned and operated by the Atlantic Seaboard Corporation in West Virginia.

The significant fact about this wellhead, a standard unit readily available from National Supply, is that it meets all the requirements of storage field service. Complete control is possible with standard National units.

You usually find National Supply wellheads in storage fields such as this Terra Alta installation. One important reason is that National Supply sells a *complete* line of advanced wellhead assemblies and has an experienced staff to service this equipment in the field.

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Investigate the many advantages of buying wellheads from National Supply. Get details by calling your closest store, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pa.

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GAS HIGHLIGHTS

AGA okays Harris bill (all but one section)

AGA directors, meeting during the association's 43rd annual convention (Dallas, early October), voted to support the Harris gas bill—if one section is deleted. That section would prohibit a gas company from filing for a rate increase while a previous filing is unsettled.

Potter lauds area pricing, industry spirit

Outgoing AGA president L. T. Potter called the FPC area-pricing policy "a masterful effort to establish something workable in regulation of field prices for gas." In his presidential message, Potter also said: "Our industry is moving as it has never moved before . . . and it will do even better in the years to come . . . because we have overwhelming evidence that the spirit of our industry is at a high level of quality and intensity." Among the evidence cited by Potter was: the Gas Industry Development Committee, the Special Committee of Executives on Regulatory Affairs, and the Industry Understanding Committee.

"Educate public!" INGAA's Elmer warns AGA members

If distribution companies don't help cure regulatory headaches now suffered by producers and pipeliners, they will also suffer, AGA members were warned by W. M. Elmer, president of Texas Gas Transmission Corp. and newly elected president of the Independent Natural Gas Association of America. He noted that the financial reputations of producers and pipeliners have already suffered and that distribution companies will too "unless we do something to remedy the situation." His remedy: a unified, aggressive, public-education program.

Hearing aftermath: Philly council tells UGI how to run Philly Gas Works

A 75-page council committee report recommends: give council approval authority over PGW's annual capital program and gas purchase contracts, eliminate UGI member on gas commission, set up director and staff to supervise PGW operations, raise UGI's annual return to city $2 million to $7.2 million—retroactive for at least two years.

Texas' gas tax challenged

Texas' new tax on natural gas has been challenged before the Texas state courts by three interstate pipeline companies, Michigan-Wisconsin Pipe Line Co., Panhandle Eastern Pipe Line Co., and Transcontinental Gas Pipe Line Co. The pipeliners claim the levy puts an unconstitutional burden on gas shipped to other states. Under the recently passed law, a minimum tax of 1 cent/Mcf is levied on all gas produced in the state, regardless of where it is consumed. Similar laws, passed in 1951 and 1959, were declared invalid by Texas courts.

Two rounds for Champ Gasco

In that monumental battle for the southern California gasweight championship, Champ Gasco vs. Kid Enchilada, the opponents of the Enchilada Inch (proposed Mexican-American pipeline) presented their case in late September and early October rounds. Major points in the SoCal, So-Counties Gas Co.'s presentation: their current contract with SoCal Edison would save that company $116.8 million (as compared to the Mexican project) over the next 20 years; and under a new contract offered by the gas companies to Edison, the saving would be over $150 million in only a nine-year period.

Kuykendall Resigns

Commissioner Jerome K. Kuykendall, FPC member since May, 1953, resigned effective Jan. 1, 1962. Republican Kuykendall's term was due to end in June, 1962. The President accepted resignation on Oct. 16.

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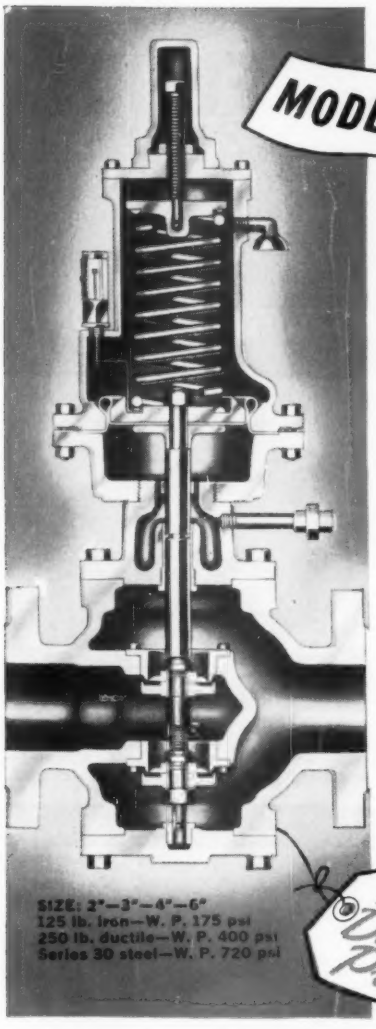
MODELS

441 461-57S

Gas Regulator



Model 57-S, for pounds-to-pounds service, operates on a new principle which maintains accurate control throughout full valve travel. The *patented* diaphragm action compensates for the "fall-off" in conventional spring regulators, which greatly limits their capacity to allowable droop. You can reduce costs greatly by installing a 57-S, one or even two sizes smaller than previously, to deliver the same volume. Usable Capacity = 100% of potential capacity. Controlled pressures—3 to 75 psi—with *one* assembly.

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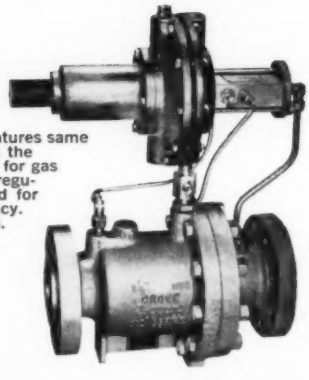
Model 80-820 where extreme accuracy is critical. Sensitive, spring loaded model 820 Grove pilot is a diaphragm controlled, three-way throttling valve. Seven adjustable spring ranges from 2 psi to 1200 psi. Send for Bulletin #813-B.

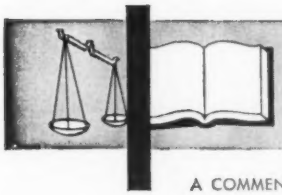


Model 80-830 features same type of pilot as the 80-820, adapted for gas back pressure regulation. Designed for extreme accuracy. Bulletin #813-B.

Grove Sets Regulator Standards for Others to follow

Model 80-896A, designed for "pounds to ounces" pressure reduction. For inlet pressures to 100 psi and adjustable control ranges from 2 ounces to 20 psi. Bulletin 813-B.

Model 80-833, for low pressure services. 833 pilot is available with three adjustable spring ranges: 10-30 psi, 15-75 psi and 25-150 psi. Bulletin #813-B.



Regulatory and Legislative Trends

A COMMENTARY ON NATIONAL AND STATE DEVELOPMENTS BY AN EXPERT IN UTILITY LAW

The Hand of justice

OUR Constitutional government with its legislative, executive and judicial branches has produced men to match the mountains of responsibility. Even though our republic, in contrast with a dictatorship, is a government of laws, the men who operate our government contribute much to its effectiveness. The late Federal Judge Learned Hand was one of those respected men. He was called the greatest jurist of his time. His superior service is an inspiration and maintains our faith in the judicial branch. Businessmen are destined to know more and more about our government or lag behind in making enlightened decisions. Let us look at a thumbnail biography of Judge Hand, and hold him up as an example of extraordinary professional competence.

• Education and experience of Judge Hand

When he was named Learned, his parents had confidence and foresight, because he was graduated from Harvard *summa cum laude.* He also distinguished himself in Harvard Law School. As a young lawyer in Albany, N. Y., he was a success, but he yearned to be a judge. His father and grandfather were both outstanding judges. Learned Hand was appointed a federal district judge by President Taft. President Coolidge later promoted him to the Second Circuit Court of Appeals and Judge Hand soon made it an esteemed court. The only higher court is the United States Supreme Court, and fickle fate did not elevate him to that tribunal although he was the national choice by merit. Judge Hand served 52 years as a federal judge, the longest judicial service in history. He was often quoted by the United States Supreme Court. His opinions cut to the heart of the subject and then moved swiftly and logically to complete the operation. Many important cases were decided in his court, but he is especially admired for his landmark decisions in the aluminum monopoly case and in the case upholding the conviction of 11 top Communists.

• Private monopolies and Judge Hand

Judge Hand reversed a lower court in the case of *United States v. Aluminum Company of America* and declared that good monopolies are no more lawful than bad monopolies. His concise, penetrating and pulverizing decision in 1945, based upon an analysis of 40,000 pages of testimony, has been used as a precedent in many later antitrust cases.

Judge Hand concluded that Alcoa's control over the ingot aluminum market was more than 90 per cent. He asserted: "It is no excuse for 'monopolizing' a market that the monopoly has not been used to extract from the consumer more than a 'fair' profit. The Act has wider purposes. Indeed, even though we disregarded all but economic considerations, it would by no means follow that such concentration of producing power is to be desired, when it has not been used extortionately. Many people believe that possession of unchallenged economic power deadens initiative, discourages thrift and depresses energy; that immunity from competition is a narcotic, and rivalry is a stimulant, to industrial progress; that the spur of constant stress is necessary to counteract an inevitable disposition to let well enough alone. Such people believe that competitors, versed in the craft as no consumer can be, will be quick to detect opportunities for saving and new shifts in production, and be eager to profit by them. In any event the mere fact that a producer, having command of the domestic market, has not been able to make more than a 'fair' profit is no evidence that a 'fair' profit could not have been made at lower prices. True, it might have been thought adequate to condemn only those monopolies which could not show that they had exercised the highest possible ingenuity, had adopted every possible economy, had anticipated every conceivable improvement, stimulated every possible demand. No doubt, that would be one way of dealing with the matter, although it would imply constant scrutiny and constant supervision, such as courts are unable to provide. Be that as it may, that was not the way that Congress chose; it did not condone 'good trusts' and condemn 'bad' ones; it forbad all. Moreover, in so doing it was not necessarily actuated by economic motives alone. It is possible, because of its indirect social or moral effect, to prefer a system of small producers, each dependent for his success upon his own skill and character, to one in which the great mass of those engaged must accept the direction of a few. These considerations, which we have suggested only as possible purposes of the Act, we think the decisions prove to have been in fact its purposes."

Judge Hand's literary, informative and convincing style are shown in his finding that Alcoa intended its complete hold upon the ingot market. He found that Alcoa unlawfully monopolized that market, stating: "'Alcoa's' size was 'magnified' to make it a 'monopoly'; indeed, it has never been anything else; and its size, not only offered it an 'opportunity for abuse,' but it 'utilized' its size for 'abuse,' as can easily be shown.

"It would completely misconstrue

'Alcoa's' position in 1940 to hold that it was the passive beneficiary of a monopoly, following upon an involuntary elimination of competitors by automatically operative economic forces. Already in 1909, when its last lawful monopoly ended, it sought to strengthen its position by unlawful practices, and these concededly continued until 1912. In that year it had two plants in New York, at which it produced less than 42 million pounds of ingot; in 1934 it had five plants (the original two, enlarged; one in Tennessee; one in North Carolina; one in Washington), and its production had risen to about 327 million pounds, an increase of almost eightfold. Meanwhile not a pound of ingot had been produced by anyone else in the United States. This increase and this continued and undisturbed control did not fall undesigned into 'Alcoa's' lap; obviously it could not have done so. It could only have resulted, as it did result, from a persistent determination to maintain the control, with which it found itself vested in 1912. There were at least one or two abortive attempts to enter the industry, but 'Alcoa' effectively anticipated and forestalled all competition, and succeeded in holding the field alone. True, it stimulated demand and opened new uses for the metal, but not without making sure that it could supply what it had evoked. There is no dispute as to this; 'Alcoa' avows it as evidence of the skill, energy and initiative with which it has always conducted its business; as a reason why, having won its way by fair means, it should be commended, and not dismembered. We need charge it with no moral derelictions after 1912; we may assume that all it claims for itself is true. The only question is whether it falls within the exception established in favor of those who do not seek, but cannot avoid, the control of a market. It seems to us that that question scarcely survives its statement. It was not inevitable that it should always anticipate increases in the demand for ingot and be prepared to supply them. Nothing compelled it to keep doubling and redoubling its capacity before others entered the field. It insists that it never excluded competitors; but we can think of no more effective exclusion than progressively to embrace each new opportunity as it opened, and to face every newcomer with new capacity already geared into a great organization, having the advantage of experience, trade connections and the elite of personnel. Only in case we interpret 'exclusion' as limited to maneuvers not honestly industrial, but actuated solely by a desire to prevent competition, can such a course, indefatigably pursued, be deemed not 'exclusionary.' So to limit it would in our judgment emasculate the Act; would permit just such consolidations as it was designed to prevent."

To make a comparison between the aluminum monopoly and the gas industry can be helpful. The private monopoly of the ingot aluminum market was condemned, because the free forces of competition ensure the consumer a fair price, and Congress fosters such competition for the public good. By contrast public utilities, including the gas industry, are encouraged as regulated semi-monopolies. For example, regulation of gas utilities is a substitute for competition and ensures a reasonable price to the customer. It is recognized that unnecessary duplication of facilities of a gas company is an economic waste and that regulation gets good results.

Back to justice administered by Learned Hand. Eugene Dennis and 10 others were convicted in a federal district court for violating the Smith Act. The defendants had conspired to organize the Communist Party of the United States to teach and advocate the overthrow of the government by force and violence. On appeal, Judge Hand wrote the opinion affirming the judgment. His searching and searing opinion in 1950 was encouraging to every thinking American. The United States Supreme Court later affirmed Judge Hand's decision by agreeing that there was a clear and present danger of the evil that Congress had a right to prevent.

Judge Hand wrote using his pen as effectively as if it were a sword: "In each case they must ask whether the gravity of the 'evil," discounted by its improbability, justifies such invasion of free speech as is necessary to avoid the danger. We have purposely substituted 'improbability' for 'remoteness,' because that must be the right interpretation. Given the same probability, it would be wholly irrational to condone future evils which we should prevent if they were immediate; that could be reconciled only by an indifference to those who come after us. It is only because a substantial intervening period between the utterance and its realization may check its effect and change its importance. * * * We can never forecast with certainty; all prophecy is a guess, but the reliability of a guess decreases with the length of the future which it seeks to penetrate. In application of such a standard courts may strike a wrong balance; they may tolerate 'incitements' which they should forbid; they may repress utterances they should allow; but that is a responsibility that they cannot avoid. Abdication is as much a failure of duty, as indifference is a failure to protect primal rights.

"In the case at bar the defense seems to us to kick the beam. One may reasonably think it wiser in the long run to let an unhappy, bitter outcast vent his venom before any crowds he can muster and in any terms that he wishes, be they as ferocious as he will; one may trust that his patent impotence will be a foil to anything he may propose. Indeed, it is a measure of the confidence of a society in its own stability that it suffers such fustian to go unchecked. Here we are faced with something very different. The American Communist Party, of which the defendants are the controlling spirits, is a highly articulated, well contrived, far spread organization, numbering thousands of adherents, rigidly and ruthlessly disciplined, many of whom are infused with a passionate Utopian faith that is to redeem mankind. It has its Founder, its apostles, its sacred texts — perhaps even its martyrs. It seeks converts far and wide by an extensive system of schooling, demanding of all an inflexible doctrinal orthodoxy. The violent capture of all existing governments is one article of the creed of that faith, which abjures the possibility of success by lawful means. That article, which is a commonplace among initiates, is a part of

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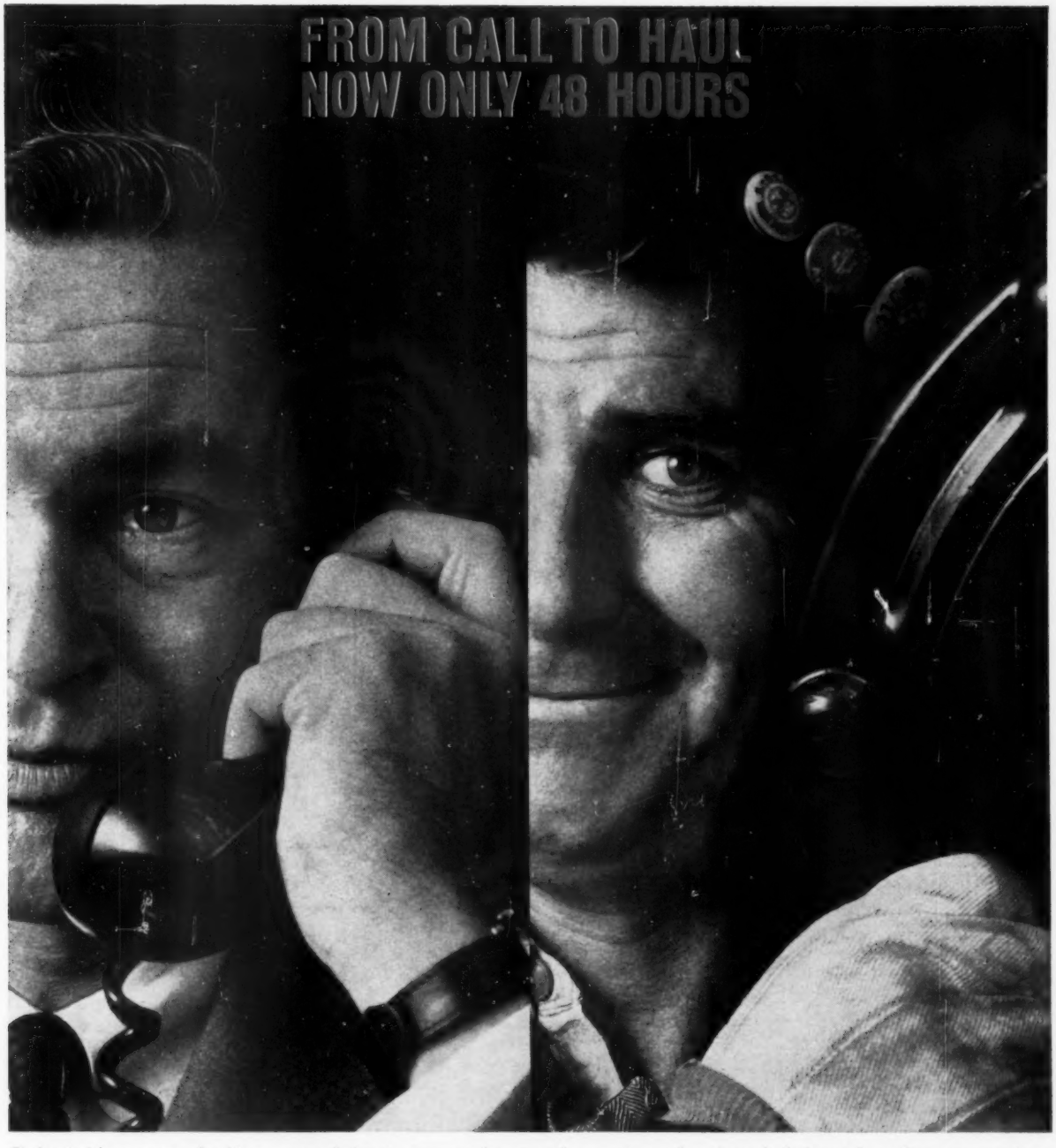

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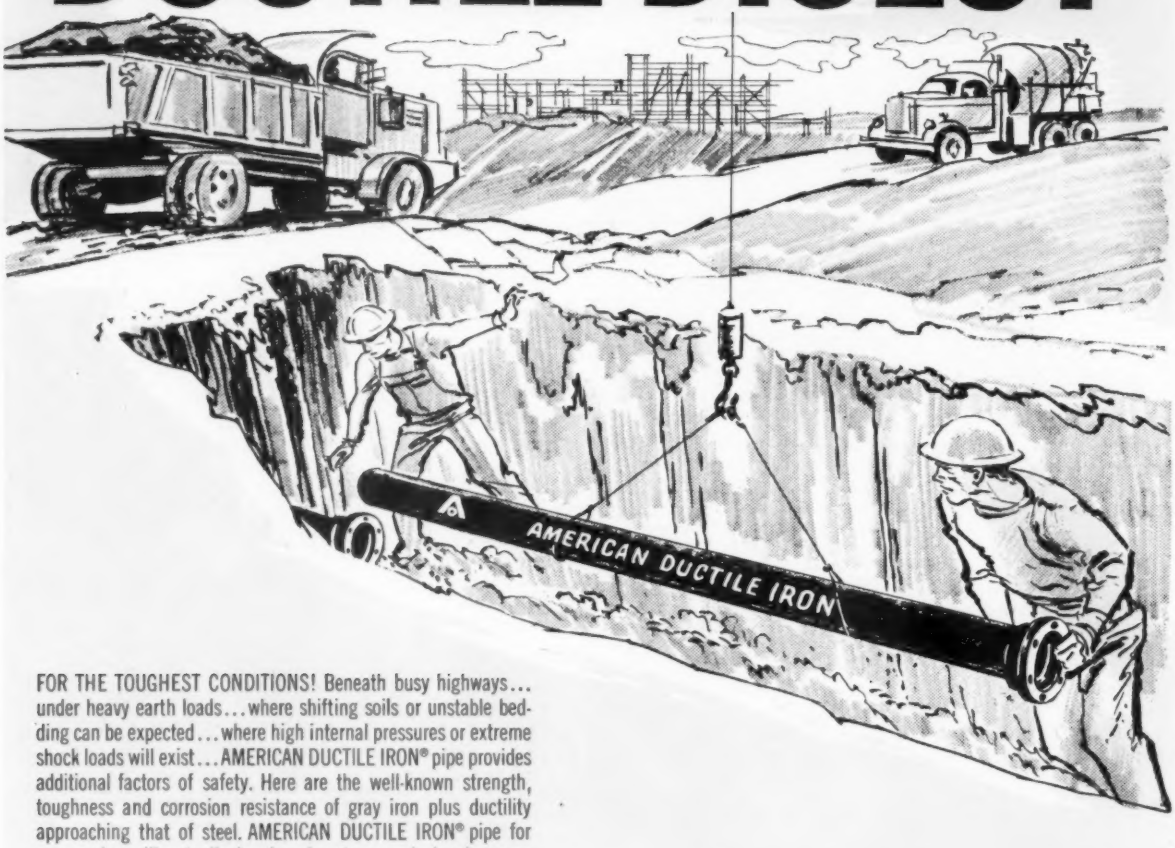

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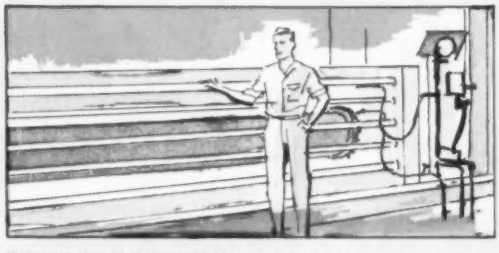

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TECHNICAL TRENDS

By GUY CORFIELD
Professional Engineer,
Los Angeles

The Gas-Fueled Turbine

Seldom has there been more interest within the gas industry than that now exhibited in the gas turbine. The turbine as such is by no means new. It has been used in many applications for producing rotative power from the burning of a variety of fuels. It can be direct fired by consuming fuel within itself; or it can receive its operating energy from remote produced steam, as in a steam turbine-driven electric generating plant. Here we are discussing the direct fuel-fired type burning natural gas.

In recent years the turbine has appeared in gas industry operations, coupled to centrifugal compressors, for "pumping" gas through the transmission pipe lines. These compressor station turbines, however, are relatively large, heavy and slow speed. The most recent and more versatile development is the adaptation of the smaller, lighter, high speed "airplane" type of turbine, in sizes down to a few hundred horsepower, as prime movers burning natural gas and suitable for commercial or small industrial uses. The airplane type of turbine is now becoming familiar to the general public as powering jet aircraft. It is used by that industry also for auxiliary power sources in the planes, and for mobile ground support to drive electric generators, produce compressed air, etc. These turbines, of course, burn gasoline or jet fuel when airborne and can use a variety of liquid fuels on the ground. In aerial applications particularly, light weight and high power output are essentials. Long life and high efficiency can be subordinated. For commercial and industrial uses weight is not so important and long life and efficiency are imperative. For gas industry interest, the turbines must burn natural gas.

The direct-fuel burning turbine is a simple assembly. It consists essentially of a combustion chamber producing hot combustion products which pass across and impart rotation to circular bladed wheels (sometimes themselves called turbines or power turbines) fixed to a shaft which provides the power output. The hot combustion products at a somewhat reduced temperature then pass out through the exhaust. The combustion takes place in a supercharged manner, above atmospheric pressure, with a high percentage of excess air to produce a large volume of products from a relatively small combustion chamber. To accomplish this, the assembly draws in and compresses its own combustion air. This is done by another bladed wheel (commonly called an inducer and impeller, or compressor) also fixed to the power shaft. Therefore, from the combustion standpoint, the turbine in a sense "lifts itself by its own bootstraps." To get it started, the turbine must be rotated by some external source of power until it gains enough speed to pump its own combustion air. Because the combustion chamber is supercharged, gas fuel must be available for injection at a pressure of 75 to 100 psig. This limits gas turbines to locations where high pressure gas is available, unless an accessory gas compressor is provided. At least one turbine manufacturer is therefore developing an integral gas compressor, which can take the form of a small bladed wheel somewhat like the air impeller, attached to the turbine shaft also. It is designed to compress gas in sufficient volume, from the always available inches of water pressure to the required pounds pressure.

The gas turbine is intriguing because of its simplicity. It is also intriguing because of its flexibility, and its high overall efficiency in many applications. As so far described, its function would be as a prime mover (to produce rotative power) with discharge of waste heat. In this type of operation it is about 20 per cent thermally efficient, but some of the waste heat can be recovered in a recuperator and used to pre-heat the combustion air, which will increase the efficiency to about 25 per cent. It can be designed to produce more compressed air than necessary for its combustion, in which case it can be a combined prime mover and air compressor, or essentially an air compressor. Additional heat can be recovered in a waste heat boiler and used for a variety of purposes. This materially increases the overall thermal efficiency. Finally, it can be designed essentially as a hot combustion products producer, i.e., a gas burner, developing only enough shaft power to supply its combustion air and move its combustion products. In this modification it can, for instance, supply heat for a drying operation and motivate power for moving the heat through the dryer. In this use it can approach 100 per cent efficiency.

Particularly because of these combination services which the gas turbine can perform with high efficiency, the gas industry is pressing both development and application. One of the most promising applications is to provide, exclusively through the gas service line, all the energy requirements of a school, supermarket, shopping center, commercial building, etc. Turbines can drive generators to provide electricity for lighting and general electrical services. Exhaust heat can be utilized through waste heat boilers or other heat exchange equipment. This heat can produce air cooling and refrigeration in absorption refrigeration apparatus, and provide comfort heating and water heating. One of these combination installations has already been made, and others are in process.

There seems to be little doubt that these turbines are opening up a big new field for gas utilization, of interest to both gas utilities and turbine manufacturers.

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for the tough ones . . .

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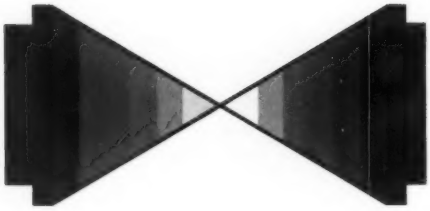

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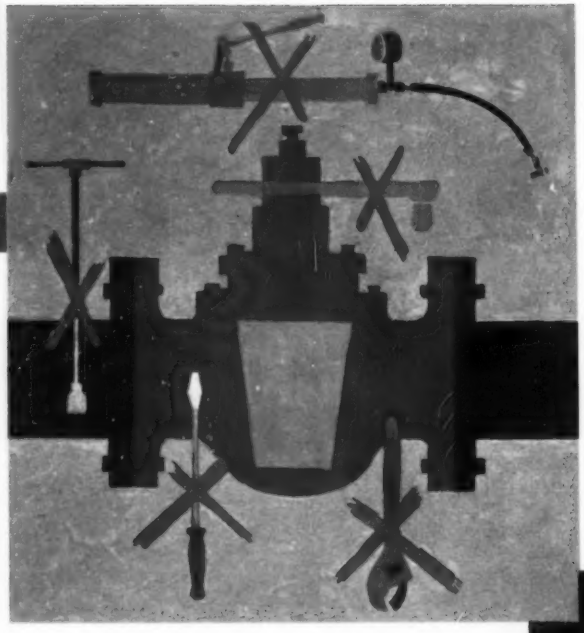
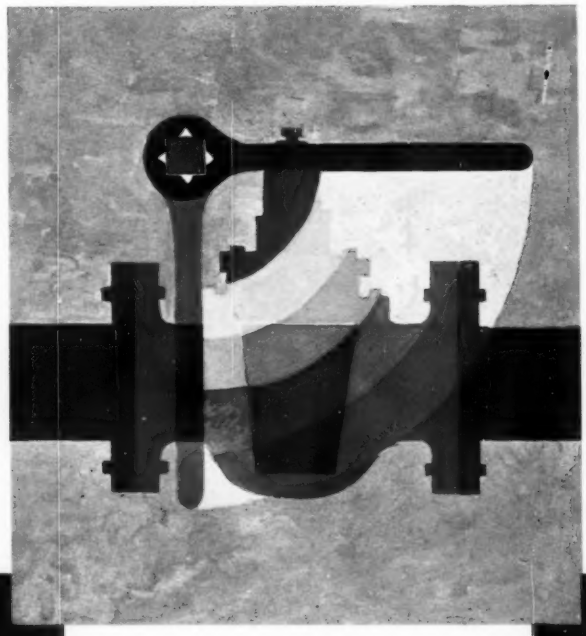




Attention-Free Performance

Some valve users put a premium on a valve that can be installed and forgotten —that needs no attention. For many non-critical services, this kind of valve is adequate: the new Rockwell PERMATURN valves can be used in such services with no attention—and with excellent results.

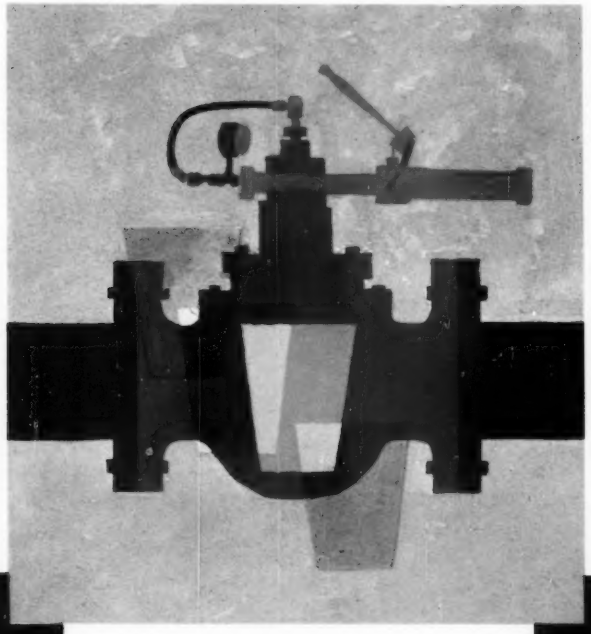
Easy 90°-Turn Operation

Fast opening and closing are easier with the new Rockwell PERMATURN than with any other valve ever developed. Just a quick, smooth quarter-turn from full-open to shut-off, and this unique valve design assures low-torque operation always—that's where the name PERMATURN comes from!

LIFT THESE PAGES for more information on this exciting new valve l

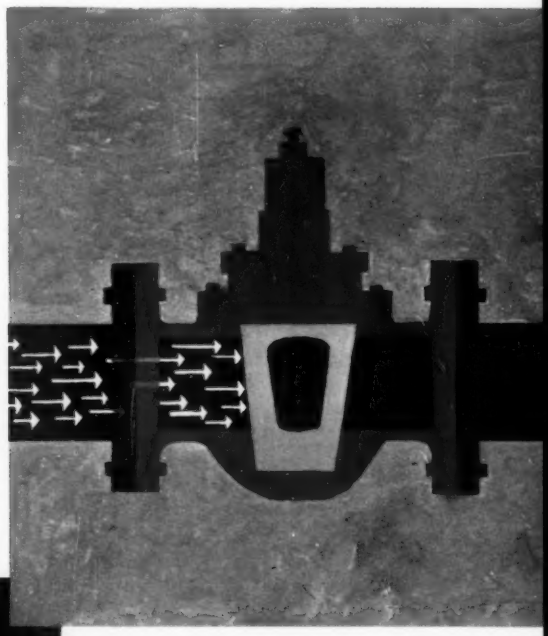
RMATURN® VALVE DESIGN!

valve, you get all the features needed application to any fluid control service



Push-Button Seat Replacement

Here's a feature you'll find in no other type valve: you can put a new seating surface in the new PERMATURN valve in seconds, *without loosening a single bolt.* You can replace valve seats as often as you like—no more putting up with leaky valves. You add years of life—and save money—with this performance-extending feature of PERMATURN valves.



Drop-Tight Sealing

There are some valve applications where there's just no substitute for the bottle-tight, wear-defying characteristics of the new Rockwell PERMATURN valve used with a *regular program of sealant replacement.* And in these critical services, the PERMATURN valve has dramatically reduced operating torque requirements.

line!

THE NEW ROCKWELL

available in all sizes

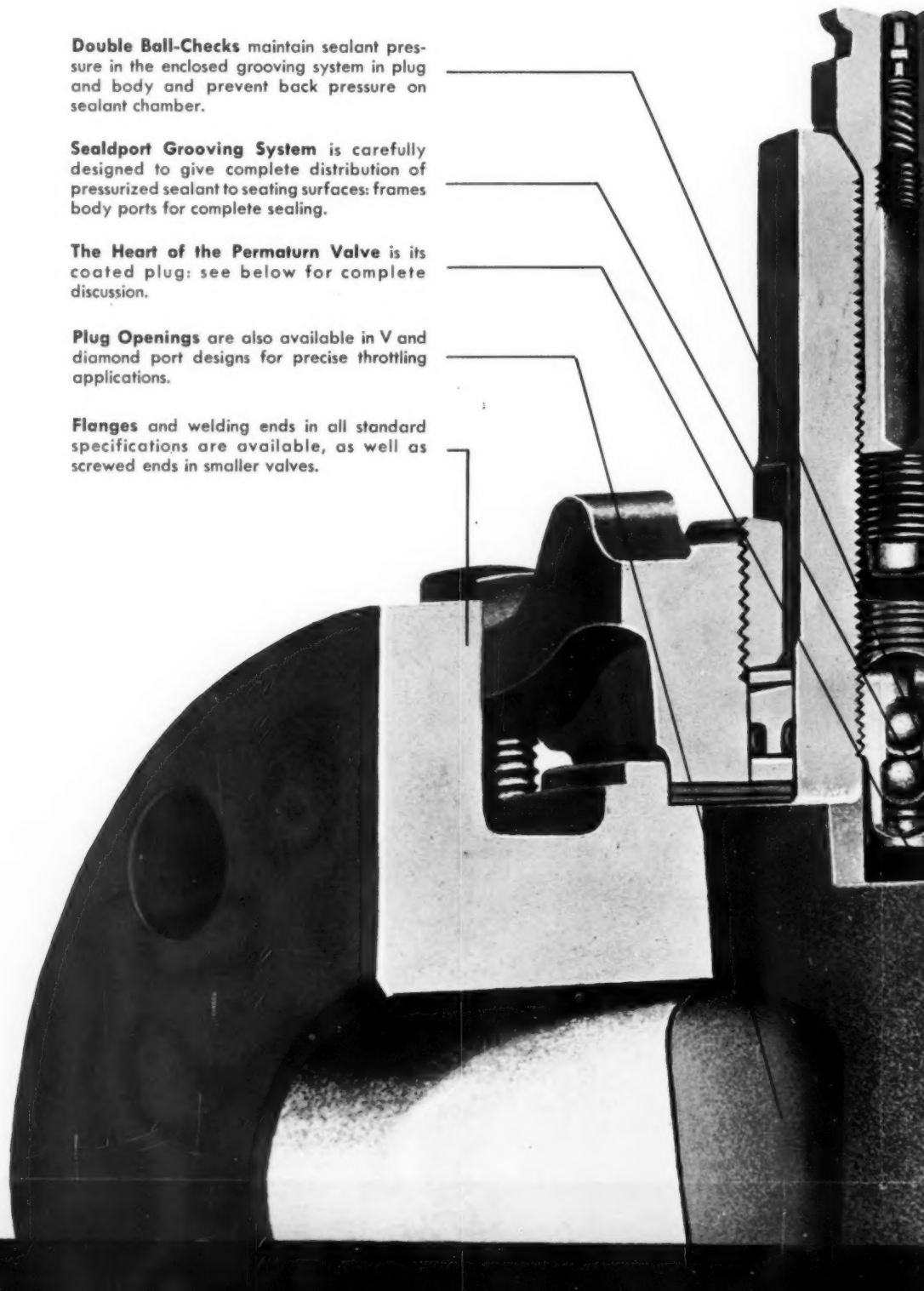
Double Ball-Checks maintain sealant pressure in the enclosed grooving system in plug and body and prevent back pressure on sealant chamber.

Sealdport Grooving System is carefully designed to give complete distribution of pressurized sealant to seating surfaces: frames body ports for complete sealing.

The Heart of the Permaturn Valve is its coated plug: see below for complete discussion.

Plug Openings are also available in V and diamond port designs for precise throttling applications.

Flanges and welding ends in all standard specifications are available, as well as screwed ends in smaller valves.

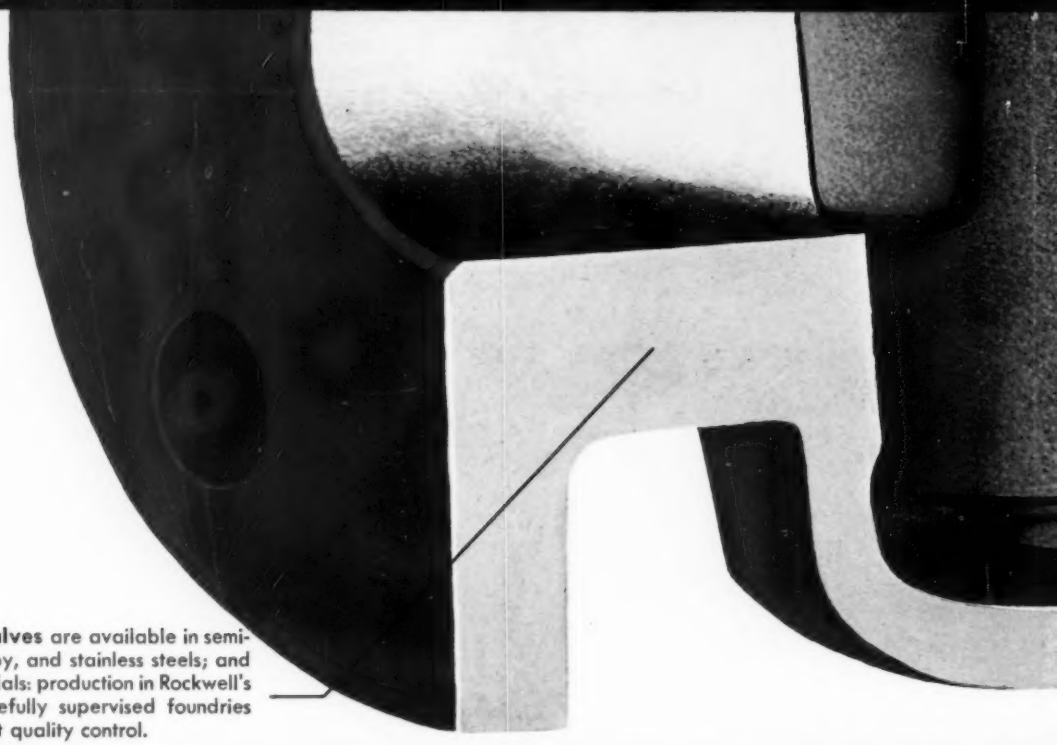


PERMATURN® VALVES

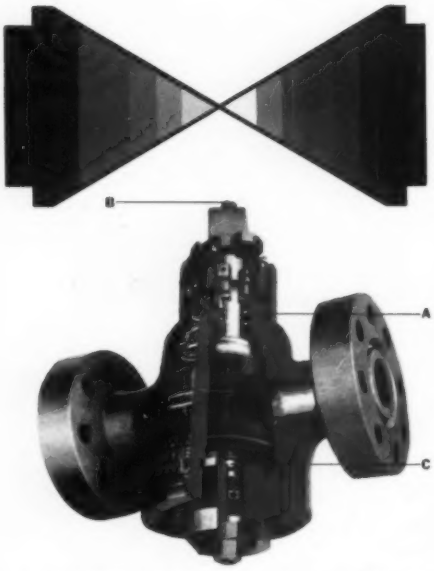
s for all pressures

Button-Head Fitting provides for simple, quick injection of plastic sealant into PERMA-TURN valves for instant seat replacement. Fitting also serves as compression screw when sealant is used in stick form: can be removed under pressure.

Fixed Adjustment Assembly is set at the factory for proper sealing fit and operating torque: requires no further adjustment or attention in the field. (See detail) *Slotted gland* is set at factory for proper compression of *spring washer(s)*. *Washer(s)* flex slightly (.001") to allow plug to lift when pressurized sealant is injected. *O-rings* seal against leakage.



PERMATURN Valves are available in semi-steel; carbon, alloy, and stainless steels; and non-ferrous materials: production in Rockwell's own modern, carefully supervised foundries provides excellent quality control.



Rockwell PERMATURN valves are also available in the inverted plug Hypreseal® design for high pressures. Low torque operation is assured by plug coating of high lubricity and bearing-guided stem. Other features are plastic stem sealing (A), fitting for "push-button" seat replacement (B), and thrust assembly (C) for controlled plug adjustment.

The secret of the PERMATURN® valve's

The unique design feature that makes the Rockwell PERMATURN valve line applicable to all valve services is its coated plug.

Developed after five years of extensive testing, the coating has an extremely low coefficient of friction and is applied in such a way that it is *permanently bonded to the metal surface of the plug.* This tenacious lubricating film gives *permanent separation of metal surfaces* of plug and body: the valves literally cannot stick or freeze.

The inert nature of the plug coating assures permanent lubricity for easy, sure operation of the PERMATURN valve at all times. Combined with the many other new design features described above,

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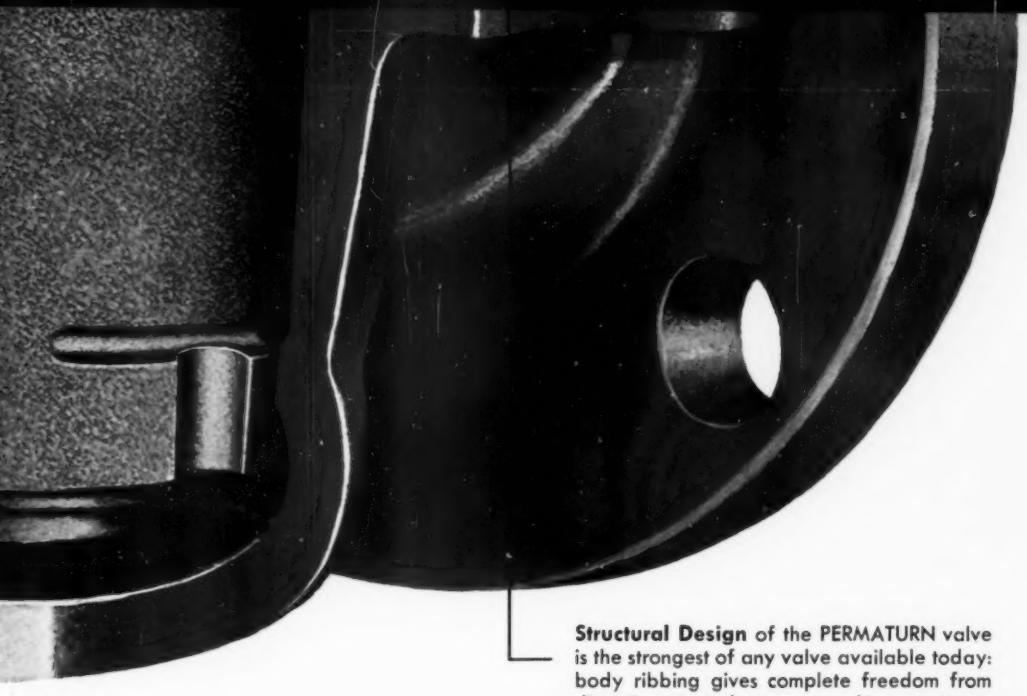


Structural Design of the PERMATURN valve is the strongest of any valve available today: body ribbing gives complete freedom from distortion at rated pressures and temperatures.

Rockwell versatility...

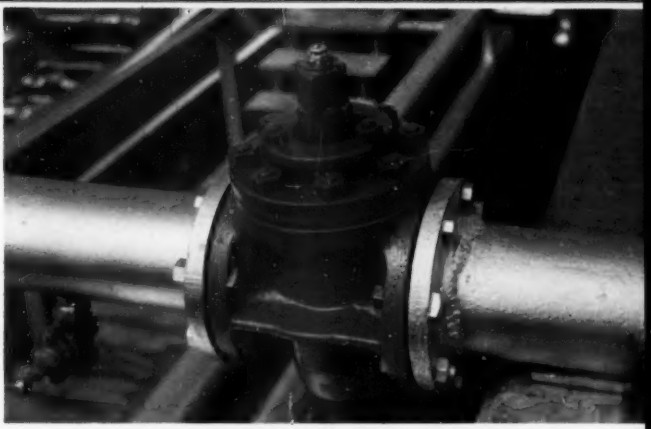
coatings give the Rockwell PERMATURN ese versatile application benefits:

on-Free Performance in services where andled do not require a special valve.

0°-Turn Operation in all valve services, ere remote operation or infrequent atten- involved.

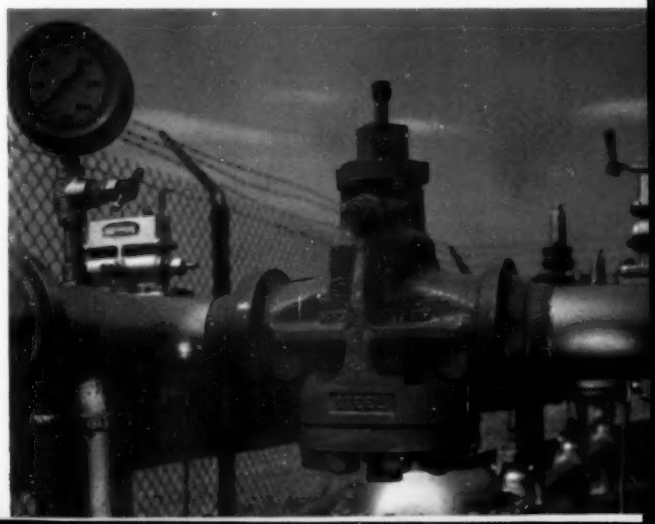
Button" Seat Replacement extending valve ss without costly downtime and maintenance.

ght Sealing for critical applications where ture is all-important.

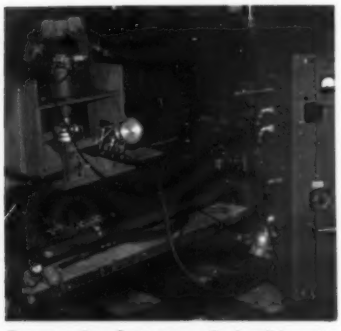


Rockwell semi-steel PERMATURN valves are shipped with a distinctive red primer paint that has wide compatibility.

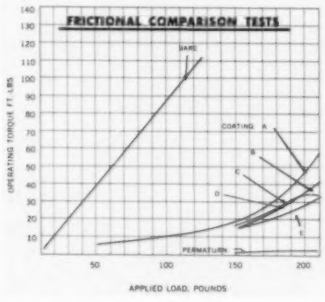
Steel PERMATURN valves are given a gray prime coat: both colors give good corrosion-protection in storage and in service.



Only Rockwell, world leader in valve research, could have developed the **PERMATURN®** valve



For more than forty years, Rockwell has pioneered in valve research. This background of experience, which made the Rockwell-Nordstrom lubricated plug valve the world's standard of quality, led to the five year development program on the PERMATURN valve, a new concept in versatile, all-purpose valve design.



Part of this study concerned the various characteristics of many compounds considered for the plug coating medium. Exhaustive mechanical and chemical resistance tests, and carefully measured frictional comparisons, led to the selection of a material which has proved its ability to stand up under tough service for years of normal valve operation.

Complete production facilities for the new PERMATURN valve have been installed at Rockwell's nationwide valve manufacturing plants. The equipment shown above was specially developed to coat the plugs of Rockwell PERMATURN valves on a production line basis and is typical of installations at other Rockwell plants.

Rockwell PERMATURN® valves have been customer-proved before introduction

NO ATTENTION has been given these Rockwell PERMATURN valves on hydrocarbon service in the year and a half since their installation. Operation is positive and easy—and shut-off is still as bottle-tight as the day the valves were installed.

JET FUEL is handled by these Rockwell PERMATURN valves, in service since 1960. Operators have found the plug coating of PERMATURN valves gives smooth, easy operation—and has reduced sealant injection needs from once-a-week to once every three months.

SURE OPERATION on tough services has been proved by pilot installations of PERMATURN valves across the country. The coated plug supplements a regular program of sealant replacement, needed in these services for long valve life, to assure low-torque operation at all times.

Rockwell Manufacturing Company
Pittsburgh 8, Pennsylvania

I'd like to have your "Pocket Valve Guide" with brief specs and coverage charts on Rockwell PERMATURN valves.

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WASHINGTON

By NEIL REGEIMBAL • GAS Washington Bureau, Washington, D. C.

New FPC speaks out

THERE'S one vast change in the new Federal Power Commission under Joseph C. Swidler—there's no shyness about speaking up. Whether the new regime's other changes in direction turn out good or bad for the industry, this trend is a major improvement.

Chairman Swidler has lost little time in making his views known to just about anyone who wants to listen. Within a couple of months of his confirmation to the commission, and before he officially took over the chair, he had spelled out his general philosophy to Washington gas representatives.

Whether the industry likes his approach or not, at least it knows where he stands thus far, and by all indications, will continue to know.

The new chairman is treading a rather delicate course, although it isn't very apparent in his statements. The Kennedy Administration, particularly the President, is "anti-business" reputation. The word is out to all cabinet officers and New Frontier officials all the way down the line to try anew to win businessmen over to his point of view, and to play down actions and philosophies which tend to irritate the business community.

This has brought soothing words of encouragement from the Labor Department and various other agencies which can easily, now that Congress is out of session, soft-peddle or sweep under the rug proposals which would antagonize businessmen.

But Mr. Swidler is admittedly dedicated to the utility control concept which the gas producers and the industry generally hate bitterly. He's not backing down, but there were indications at Houston that he has received the word from the White House to sugar-coat some of this.

His support of area pricing for producers didn't seem to match his utility bent. In fact, he made a point of disavowing cost-of-service pricing for producers, and said applying a utility-type, cost-plus formula to producers would hurt consumers.

But when the restrictions he placed on area-pricing are considered, the utility concept is there. Area prices must become ceilings, and definitely not floors or norms, he insists. While admitting that producers differ from traditional utility firms, he strictly rules out permitting supply and demand to operate in the field. Area price ceilings would not be broken except in rare circumstances and then only when a sale would not have substantial effect on the ceiling, he says.

He makes it clear that he believes the commission can develop individual cost-of-service pricing methods if the area-pricing project doesn't pan out. This backs up an earlier call for "cooperation in regulation" from the industry. If producers can't agree with the commission on applying the area pricing approach, he is ready to go back to the cost-of-service formula.

Chairman Swidler is also making it clear that he wants the industry to lay aside its continuing drive for gas legislation, at least for the time being. He blames this annual bid for congressional relief from present laws as adding to "uncertainty and confusion."

He also makes it clear that the FPC, at least for some years, will not go to bat for gas legislation.

In addition, he is pushing for regulation of in-place gas sales, for the first time.

The new chairman also has some firm ideas about how the FPC is going to be run administratively. He wants the whole regulatory process speeded up—as does just about everyone.

For one thing, he is demanding that the industry have complete cases prepared before anything is submitted—no going back to fill out holes. The FPC is going to speed up dragging field investigations, he says, and interveners are asked to pool their presentations.

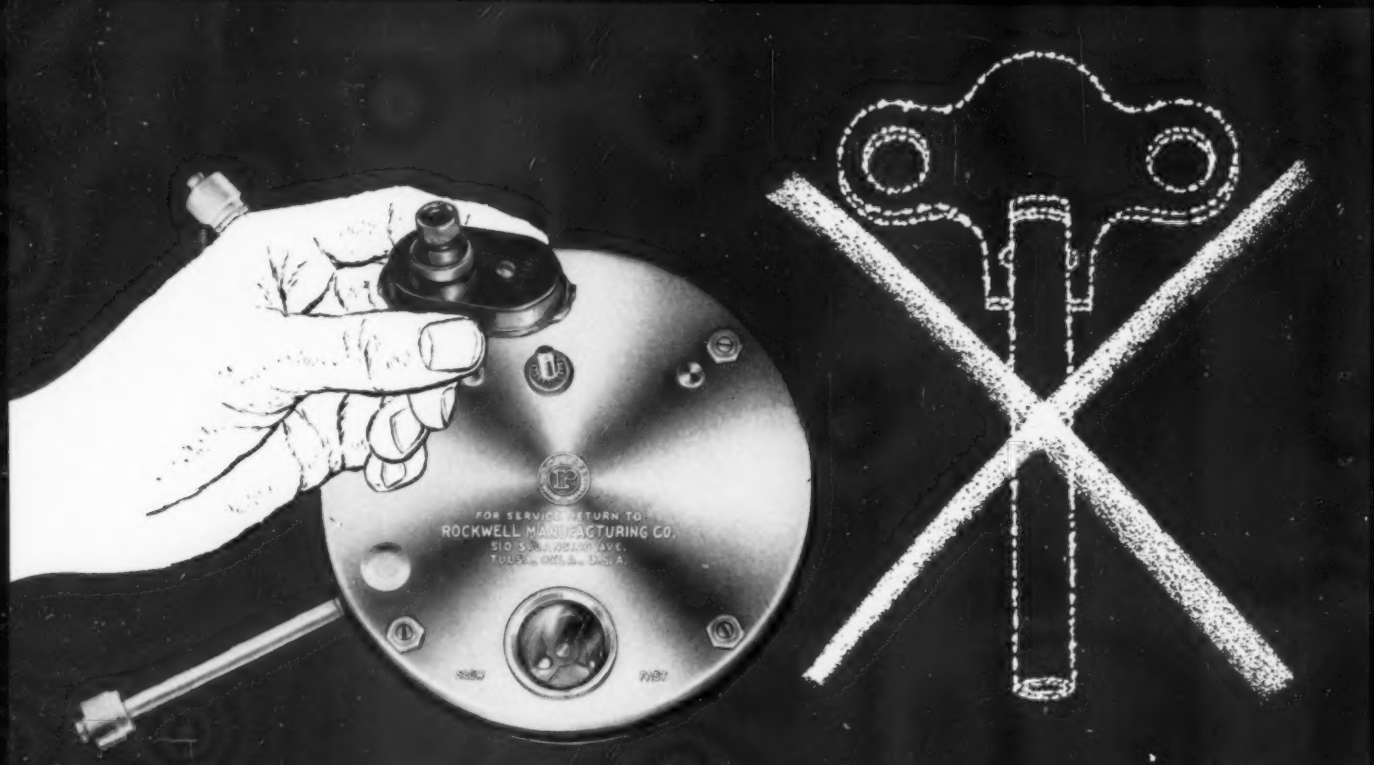
Expanding on his "clear view" intentions, the new chairman also intends to use commission policy statements. He wants each decision, and each statement, to spell out clearly the commission regulatory philosophies as they are developed, preventing any piece-by-piece confusion.

The resignation of James M. Landis as the White House "overseer" of the regulatory agencies, of which the FPC is one, gives Chairman Swidler a much clearer field to push reorganization of the commission in his own way. Mr. Landis, who resigned abruptly, had been causing considerable friction between the White House and all the agencies over how to tailor them to the New Frontier ideology.

The commission will have plenty of opportunity to develop new approaches to various major problems.

It now has the basis—if the area-pricing approach fails—to applying cost-of-service to prices of big pro-

Continued on page 100



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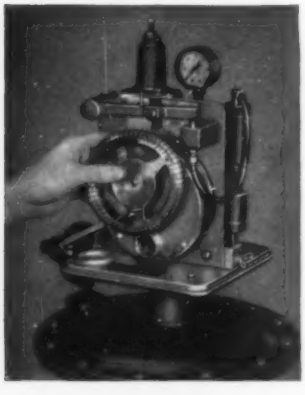

◀ Rockwell Gas Drive powers this typical intermitter

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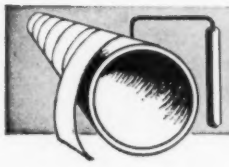


CORROSION PREVENTION

DISTRIBUTION TRANSMISSION

By MARSHALL E. PARKER • Consulting Engineer, Houston

Corrosion Responsibility

IN an organization which has an extensive amount of physical plant exposed to corrosion, how should the responsibility for the protection of this plant be delegated? A number of factors are necessarily involved in the answer to this important question, among them the size of the organization. A large company will almost always have a corrosion department; a small one often will assign this duty to a department whose primary responsibility lies somewhere else. This is a mistake, and almost invariably has expensive consequences. Even when the department has to be just one man, he should definitely be the corrosion man; if he has to perform some additional duties, they must be subordinated, and, most important of all, he must have the authority to distribute his time between the two. It will work much better if he has no duties other than corrosion.

The reason for this extreme view lies in the peculiar nature of corrosion prevention, as compared to almost any of the other activities in which an industry engages. Preventive measures are most expensive and least effective when they are taken after the need is obvious —i. e., when the line starts leaking. They are most effective and least expensive when they are taken as a result of anticipation.

It is also true that the most effective corrosion control programs are the most difficult to see; one which works perfectly is completely invisible; it cannot be seen that anything is being accomplished. For corrosion control programs can be evaluated only in terms of what they prevent, and what they prevent can only be seen when for some reason or other there is a failure in the program to perform as planned.

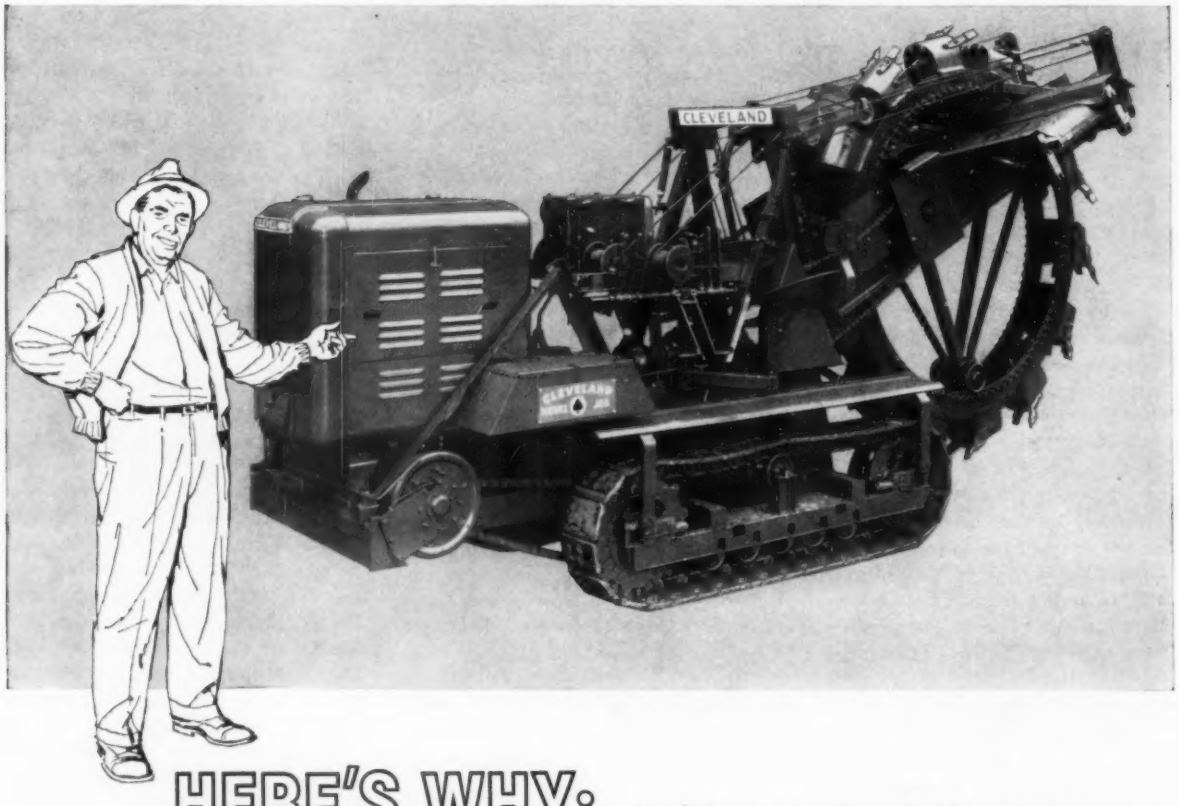
In the early part of the history of a pipeline system—and these things are applicable to many other structures involving extensive metal exposure to corrosion—when preventive measures can be applied most effectively, corrosion is never a pressing problem. And, in this stage of a system's life, there are many pressing problems. A very natural consequence of this is that, all too often, nothing is done about corrosion. One way to avoid this serious economic error is to have at least one good man whose sole responsibility is to see that something is done about corrosion. He will make a nuisance of himself to management; when all the others are running around trying to settle this right-of-way problem, or this threatened lawsuit, or prepare the data for this all-important hearing; while everybody else is busy with these pressing matters, he will be determining current requirements, locating ground bed sites, and preparing plans for the cathodic protection system which will silently and invisibly pay for itself many times over in the future.

This same conflict of pressure operates after an organization is under way, far beyond the construction and initiation stages. If the same man has responsibility for corrosion control on the pipeline, and for keeping the right-of-way, it is the latter set of duties which are going to result in telephone calls from unhappy landowners, and thus in the inevitable pressure from management. So, if there is any shortage at all of time or facilities, it is the non-pressure corrosion responsibility which will be slighted. It has been seen to happen that a man will start out with a small company with an adequate crew and enough time to take care of both of these duties; then, as the company grows, as long as he can keep up with the visible part of his job, it is very difficult for him to convince anyone that he needs more men and equipment. At this very minute, there is a pipeline company whose cathodic protection system, once adequate, has not had one single minute of attention for more than a year—the foreman and all of his men have been fully occupied with an ambitious program of new construction. Naturally, every day the contractor is at work, he has no choice but to be there. When the contractor does miss a few days, it is usually because of a storm or the like, and this brings its own demands. This man, with his present crew, will never be able to take proper care of the expanded system; if his crew had been expanded before, instead of after, the new construction, he might have been able to keep his cathodic protection system in proper operation and inspect the new construction.

To say that the corrosion control program must be the sole responsibility of one man is not necessarily to say that he must be an employee. The first stages—survey, design, installation and initial adjustment —are quite commonly, especially in the case of newly organized companies, entrusted to outside organizations. They are not subject to the pressures mentioned above, and thus can do an adequate job. The continued maintenance, and its accompanying periodic adjustment and/or revision, can also be handled by those outside the company. It is well, however, even in such a case, to have one man charged with the responsibility; whether he does any of the work himself or not, he can certainly see that it is done. In a very small organization, this one

Continued on page 102

THERE'S NOTHING LIKE THE CLEVELAND J-20 FOR DISTRIBUTION TRENCHING



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THE GASSING GAME

By JIM CLARK • Gas & Oil Consultant, Houston

WHILE no one in the gas producing industry expects many big favors from FPC Chairman Joseph C. Swidler, there was a considerable amount of relief after he made his speech to the INGAA convention in Houston.

Probably the part of Swidler's speech that did more to give producers a good impression than any other was in his discussion of area pricing and the need for cost data to support the system.

Swidler said, "By emphasizing the necessity of cost information I do not mean to imply that costs, plus a utility return, should constitute the limit of price. I fully realize that gas is not available until it is discovered and that there must be an incentive for discovering more and more gas if the industry is to remain healthy. I do not delude myself that simply recovering costs, plus a 6 per cent return on investment, is a sufficient incentive."

Already Swidler had surprised the producers by stating that he favored area pricing. Most producers had the impression that he did not favor the system because he did not vote for the Aug. 2 order, inspired by former Chairman Jerome Kuykendall. Swidler explained that his failure to vote for the order was due to his lack of knowledge on the subject at the time and that he did not feel qualified to express himself officially on so complex a matter. Since then, apparently, he has familiarized himself with area pricing and now approves it.

In a press conference, Swidler admitted that it was possible area pricing could eliminate the necessity for any other type of regulations on producers, but he added his attorneys might disagree.

Asked if he believed area pricing was in any way analogous to posted field prices for crude, Swidler said he was not familiar with crude pricing sufficiently to answer precisely in the affirmative, but that probably the two systems were similar.

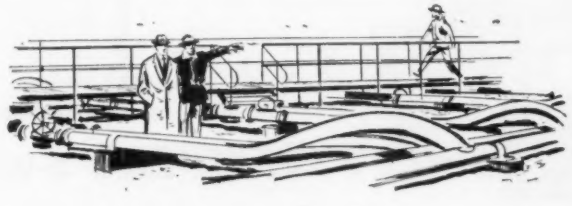
This raises the point that area pricing could, if instituted on an equitable and acceptable basis to all concerned, terminate the chaotic and confused situation that has hung over the gas producing industry since the Supreme Court's decision in the Phillips case in 1954.

What area pricing could amount to, simply, would be the price the FPC would approve for transmission lines to pay producers for natural gas in certain areas. There would then be no necessity for any other regulations on producers. They would know what they could get for the gas, that neither the FPC nor the Supreme Court would come out later and reduce the price, and they could then finance development wells.

Swidler made it plain that he did not favor any new legislation on gas. He said he had no objection to either of the bills presented to Congress, but that he feared any legislation would only serve to further confuse the issue, which he considers confused sufficiently for the time.

If area pricing can be successfully negotiated, it is possible that the producing industry itself would be satisfied with leaving things as they are and living with the Supreme Court decision. In fact, some have expressed the opinion that area pricing could do exactly what Congress intended for the Natural Gas Act of 1938 to do. That is, it could control the price of gas paid by transmission companies with no direct regulations on producers.

The posted field price for crude is really area pricing in a sense, although it is based on supply and demand rather than on regulated prices. Crude prices in a given field are based on location, the gravity of the oil, and other considerations. Under area pricing, of course, the location of the gas, the size of the reserve, the Btu content and other facts would probably be considered, plus one consideration that crude oil does not receive—production costs. ■



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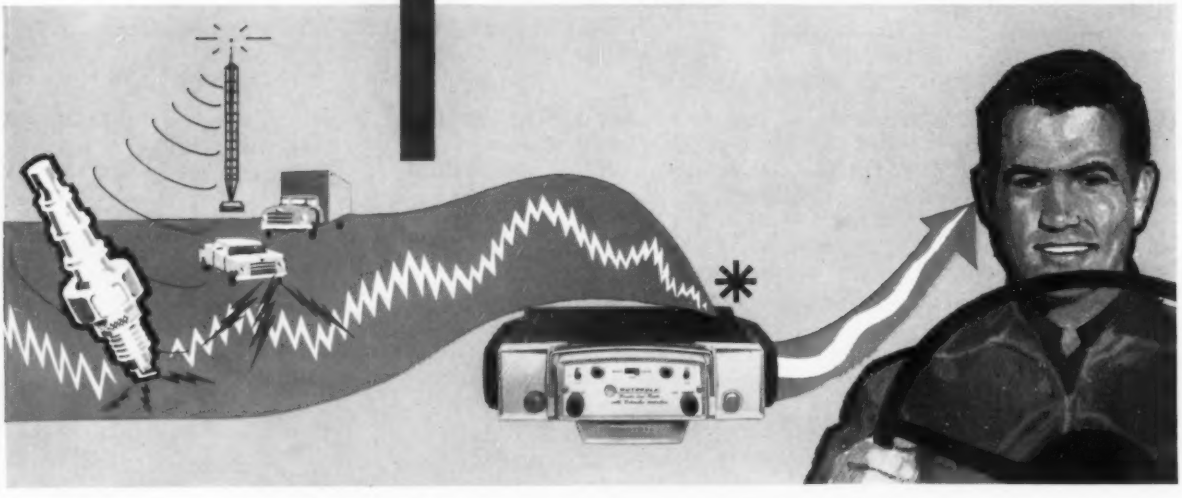

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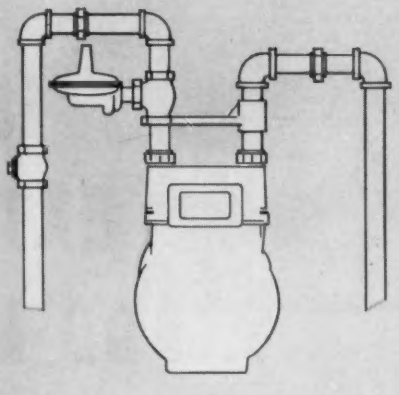

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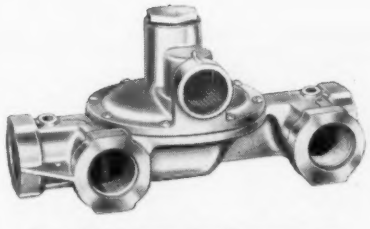
Consider also these specifications: Compact S-254 has aluminum body and casings, for strength, easy handling, low shipping costs (weight 2¾ lbs.). It's rated at 250 CFH with 2 psi inlet pressure and 7" W.C. outlet pressure. It handles inlet pressures up to 100 psi. Springs are available for reduced pressures from 3½" W.C. to 18" W.C. Both valve disc and orifice are renewable through inlet. S-254 has internal relief valve and large weather proof vent which provides full capacity relief. For complete information on the S-254 and the entire S-250 series, send for bulletin P-S250A. Fisher Governor Company, Marshalltown, Iowa. Plants in Woodstock, Ont., Rochester, England. Butterfly Valve Division: Continental Equipment Co., Coraopolis, Pa.



Type S-254 Meter Bar Body with internal relief valve, and pressure test connections for both inlet and outlet pressure. Constructed with meter couplings spaced 6" center to center.

SPECIFICATIONS

Type No.	Body Sizes	Orifice Sizes	Spring Ranges	Inlet Pressure Range
S253 (without relief)	¾" x ¾" x ¾" x ¾" 1" x 1" x 1" x 1"	⅛"—⅜"	3½"— 5½" W.C. 5¼"— 9¼" W.C.	½ to 100 psi
S254 (with relief)	¾" x 1" x 1" x 1" ¾" x ¾" x ¾" x 1"	¼"—⅜"	9"—12½" W.C. 12"—18" W.C.	

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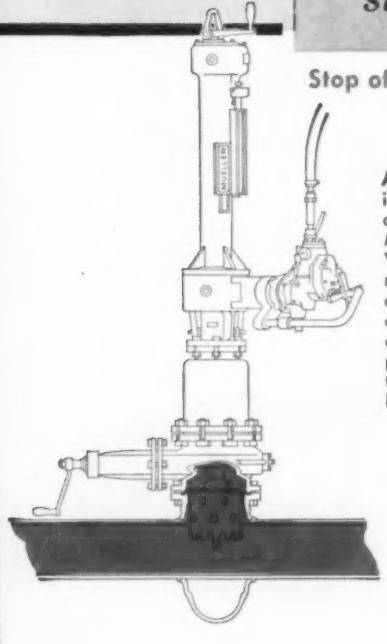
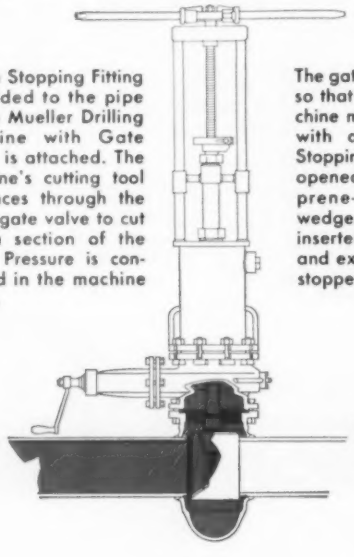
the inside story . . .

Basic steps of Mueller No-Blo Methods are shown briefly in these illustrations.

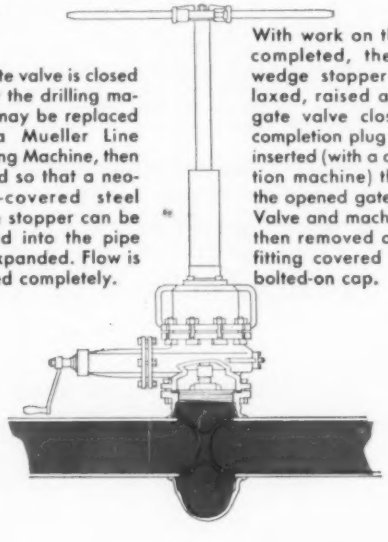
Stop off high pressure lines where no control valves exist—



A Line Stopping Fitting is welded to the pipe and a Mueller Drilling Machine with Gate Valve is attached. The machine's cutting tool advances through the open gate valve to cut out a section of the pipe. Pressure is contained in the machine body.



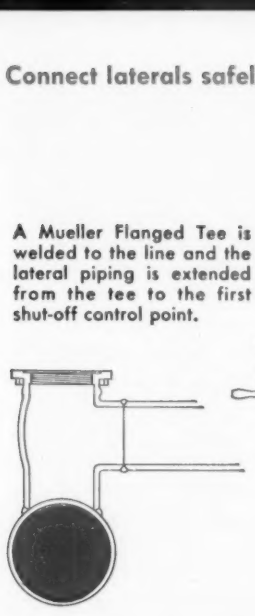
The gate valve is closed so that the drilling machine may be replaced with a Mueller Line Stopping Machine, then opened so that a neoprene-covered steel wedge stopper can be inserted into the pipe and expanded. Flow is stopped completely.



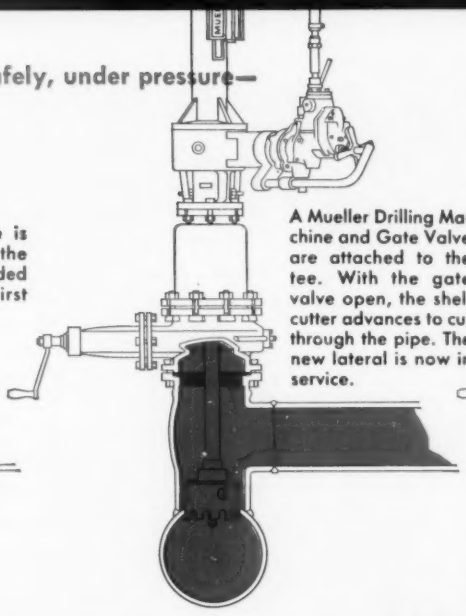
With work on the line completed, the steel wedge stopper is relaxed, raised and the gate valve closed. A completion plug is then inserted (with a completion machine) through the opened gate valve. Valve and machine are then removed and the fitting covered with a bolted-on cap.

Connect laterals safely, under pressure—

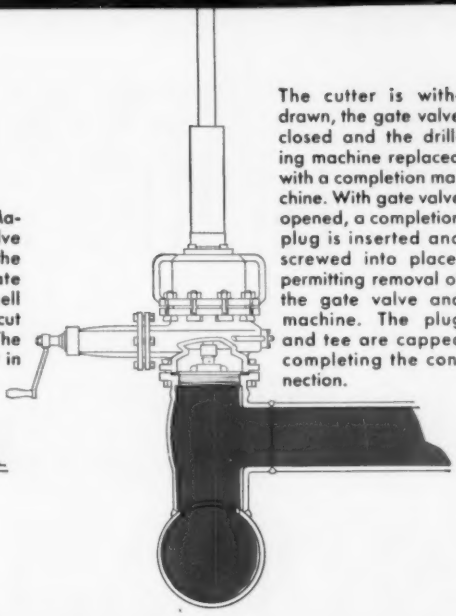
A Mueller Flanged Tee is welded to the line and the lateral piping is extended from the tee to the first shut-off control point.



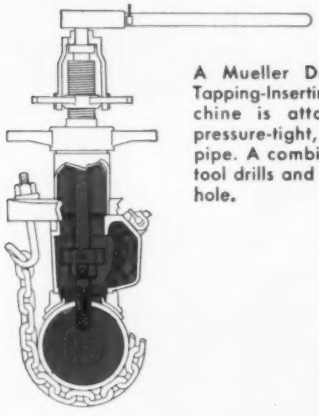
A Mueller Drilling Machine and Gate Valve are attached to the tee. With the gate valve open, the shell cutter advances to cut through the pipe. The new lateral is now in service.



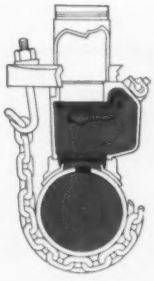
The cutter is withdrawn, the gate valve closed and the drilling machine replaced with a completion machine. With gate valve opened, a completion plug is inserted and screwed into place, permitting removal of the gate valve and machine. The plug and tee are capped completing the connection.



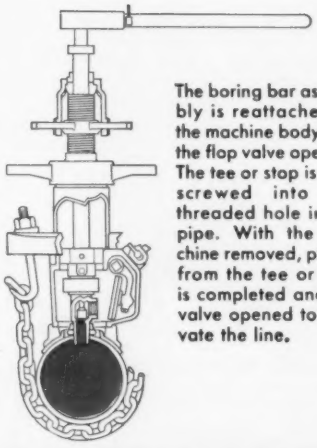
Tap a hot line without welding—



A Mueller Drilling-Tapping-Inserting Machine is attached, pressure-tight, to the pipe. A combination tool drills and taps a hole.



The tool is retracted and a flop valve in the body is closed to contain the pressure. The tool can then be removed and a valve tee or stop in closed position is attached to the boring bar.



The boring bar assembly is reattached to the machine body and the flop valve opened. The tee or stop is then screwed into the threaded hole in the pipe. With the machine removed, piping from the tee or stop is completed and the valve opened to activate the line.

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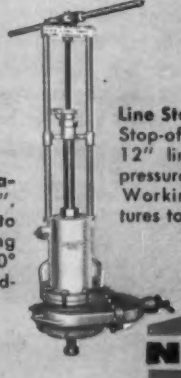
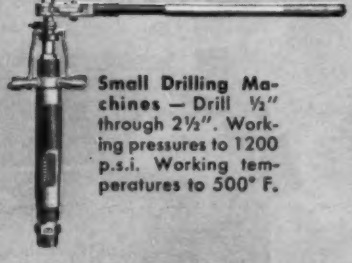


Line Stopper Units—Stop-off ¾" through 12" lines. Working pressures to 500 p.s.i. Working temperatures to 250° F.

Flanged Tees—Sizes from 3" through 8". Pressure ratings to 1200 p.s.i. Temperature ratings to 500° F.

Line Stopper Fittings — Sizes from ¾" through 12". Welding or mechanical joints. For steel, thin-wall steel or cast-iron pipe. Pressure ratings to 1200 p.s.i.

Valve Tees — Sizes through 2". Welding or threaded inlet and/or outlet. Pressure ratings to 1200 p.s.i. (Machine inserted Valve Tee — 250 p.s.i.)



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the new CHEVY II basic fleet transportation in a totally new line of cars

Chevy II 100 4-Door

This one might just fit your special fleet requirements like no other car ever has. It's built in a new runabout size with a rugged new kind of unitized body to save you money in maintenance. You have a choice of a frugal four or satiny six in most models. Durable new Mono-Plate rear springs make the Chevy II ride a study in smoothness. And just wait till you get the low-down on that price tag at your dealer's!

You've proved the Roots 3M125 for dependability, easy installation and accuracy...

now try this one for SIZE!

A 7000 cfh* line-mounted Rootsmeter less than 18″ long

Now you can have the advantages of both rotary-positive-displacement metering and line-mounting in a 7000 cfh Rootsmeter, Model 7M125, as well as in the already widely accepted 3000 cfh model.

Rootsmeters are accurate through wide ranges of pressure and flow—unaffected by fluctuations. And because of Roots proved operating principle, you can be sure the accuracy is permanent.

The new meters are designed for easy line-mounting. The 7000 cfh model is less than 18″ long, and the 3000 cfh model is only 14″ long. Connections are flanged to ASA C.I. standards, and line-mounting Rootsmeters require no special supports for simple horizontal or vertical installation.

There are a lot of other advantages in these Line-Mounted Gas Meters, too. You can easily read total flow through the convenient protective lens of the direct-reading volume register, yet the register itself is enclosed entirely within the meter case, eliminating problems incurred with external counters. And if you wish, the meter can be easily instrumented. Maintenance is simple: just replenish the oil occasionally; convenient bulls-eye oil-level gauges make checking easy. There are no internal valves, orifices, or diaphragms to wear or be damaged, and no stuffing boxes to maintain. Testing is easy too, with simple connections provided for standard proving procedures.

Whether your problems are in gas production, transmission, or distribution, or if you meter industrial or institutional gas, you'll find Line-Mounted Rootsmeters the most accurate and dependable, easiest to install, and most convenient gas meters you've ever used. Call your Roots-Connersville engineer or write for details of all the advantages of new Line-Mounted Rootsmeters.

*Dial Rate

ROOTS CONNERSVILLE

DRESSER INDUSTRIES INC.

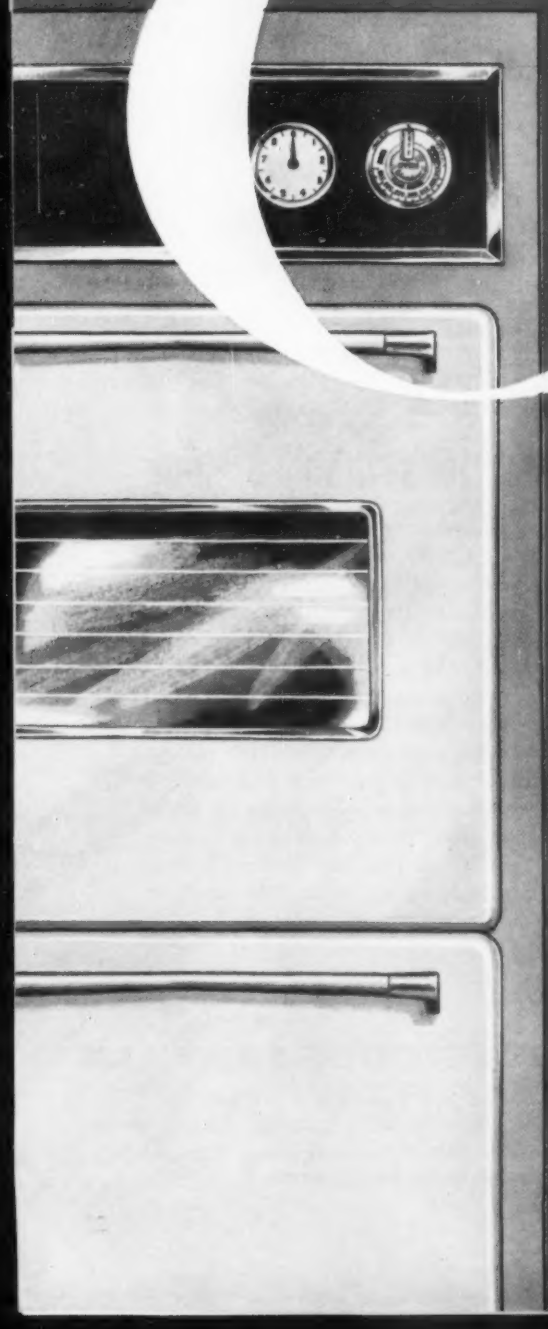
OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

ROOTS-CONNERSVILLE BLOWER DIVISION

900 W. MOUNT STREET, CONNERSVILLE, INDIANA

In Canada—Roots-Connersville Blower (Canada) Ltd., 629 Adelaide Street, West, Toronto

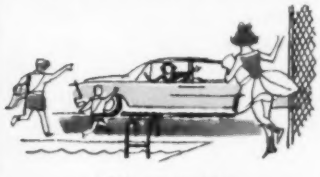
Another Robertshaw first...



Oven-a-

greatest selling feature

While the food is cooking, the homemaker can—



Pick up the kids
at the swimming pool

Take a leisurely bath
or shower

with-mind™

*since Burner-with-a-brain**

Entertain cocktail guests

It doesn't even matter if hubby is late for dinner

She never has to check the oven!

*A.G.A. MARK

This new control system will introduce the homemaker to CONVENIENCE COOKING™ . . . a new concept developed by a team of Robertshaw technicians and home economists.

Here's all the homemaker has to do:

1. Set the timer for the required cooking time.
2. Turn the Oven-with-a-mind control dial to the correct cooking temperature.

When the cooking nears completion, the control system automatically reduces the oven to an ideal serving temperature. The food is held for minutes or hours *without further cooking*. After the first setting, the homemaker doesn't have to touch the oven until she is ready to serve the food . . . *at her convenience*.

Oven-with-a-mind is an improved version of the famous Robertshaw Flame Master® control with Lo-Temp setting combined with an automatic time control.

Outstanding Convenience Cooking features:

SIMPLICITY . . . ELIMINATES COMPLEX SETTINGS. Homemaker simply makes two settings when she puts food in oven. Cooking starts immediately; she has no doubts about the oven turning itself on *after* she leaves.

HOMEMAKER "INSURANCE" . . . NO OVER-COOKING, NO RE-DIALING. She'll never again worry about having to delay dinner due to late arrivals, extended cocktails, etc. Oven-with-a-mind *automatically* holds food at optimum serving temperature. AND self-clearing feature eliminates re-setting after cooking; control returns itself to manual!

MEAT PROBE WITH INDICATOR (optional). Automatically controls oven temperature relative to internal meat temperature. When cooking nears completion, timer shows her the number of minutes remaining until meat can be served. If a delay is necessary, Oven-with-a-mind will hold meat at the selected degree of doneness for extra hours without further cooking.

PLUS REGULAR FLAME MASTER ADVANTAGES. Full range down to 140°. Thaws frozen foods; warms dishes. "No-Button" automatic oven pilot; if pilot goes out, she simply holds match to it. No costly service calls.

Up-grade your '62 sales by stressing the Convenience Cooking features of Oven-with-a-mind. VMA-9710-D

Robertshaw

MR. CONTROLS

NEW STANTON DIVISION
YOUNGWOOD, PENNSYLVANIA

The name that MEANS temperature control

NORGE

HAIR DRYER ACCESSORY

ATTACHES QUICKLY TO EVERY NORGE GAS DRYER IN USE TODAY—IN MORE THAN 1 MILLION HOMES! *(fits every new Norge Dryer too)*

A Proved Sales Booster for 1962 Norge models! Sells more gas dryers everywhere it is displayed.

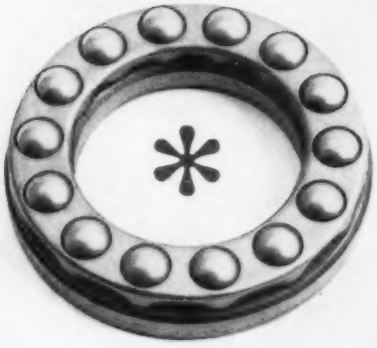
You Deliver 2 Appliances when you sell a Norge Dryer with this accessory, doubling the fuel consumption.

Doubles the Gas Load on all Norge Clothes Dryers now in customers' homes.

This is a professional, beauty-shop type hair dryer that any woman or daughter can easily slip onto a Norge Gas Clothes Dryer. ☐ And remember—while 90% of all women shampoo their hair at home, *only 27% own any kind of hair dryer.* ☐ Gas clothes dryers represent an 80% untapped market. Today's new Norge, with its *exclusive 4-Way-Drying*, does more for your customers than any other dryer made. ☐ Now the popular new hair drying attachment, one more imaginative Norge exclusive, gives you today's greatest opportunity to capture the largest share of your dryer market for *gas*.

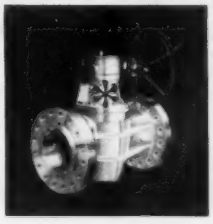
NORGE B-W BORG-WARNER

NORGE SALES CORP., SUBSIDIARY OF BORG-WARNER CORPORATION. DISTRIBUTED IN CANADA BY MOFFATS, LTD., WESTON, ONTARIO.



*This is the secret of Rolotork®

The single-unit plug-and-stem of Walworth's Rolotork Lubricated Plug Valve is mounted like the drive shaft of a fine machine tool. Superhardened ball bearings absorb thrust—as high as 100,000 pounds—yet let the valve operate without an ounce increase in torque! That's



Rolotork—all the advantages of Lubricated Plug Valves—plus fingertip operation at any line pressure. ■ And remember, the famed Walworth Service Fleet stands ready, day and night, to service your LPV's and instruct your operating personnel. Call or write today.

Executive Offices: 750 Third Ave., New York 17, N.Y. Lubricated Plug Valve Division: 3517 Polk Ave., P. O. Box 18211, Houston 23, Texas

WALWORTH **WALWORTH**

the Walworth companies: Alloy Steel Products Co.—Conoflow Corp.—Grove Valve and Regulator Co.—M&H Valve and Fittings Co.

MONEY in the bank

Piggy banks are not just for pennies. They're good for saving dollars too! (Incidentally, the idea of saving dollars also applies to Superior's AL175 hardcase gas meter.)

When you buy gas meters, you're not fooling with pennies. Your investments in meters are capital investments which must be analyzed carefully . . . there's no room for playing favorites . . . total value is what counts.

Superior hardcase meters are in use across the country because there are plenty of hard-headed buyers who want to know exactly what they're getting in terms of design, service, price, and tested performance. When they add up the *total* value, they choose Superior.

Why don't you seriously consider Superior for your metering needs. *You can specify Superior with confidence.*

neptune
for a better measure of profit

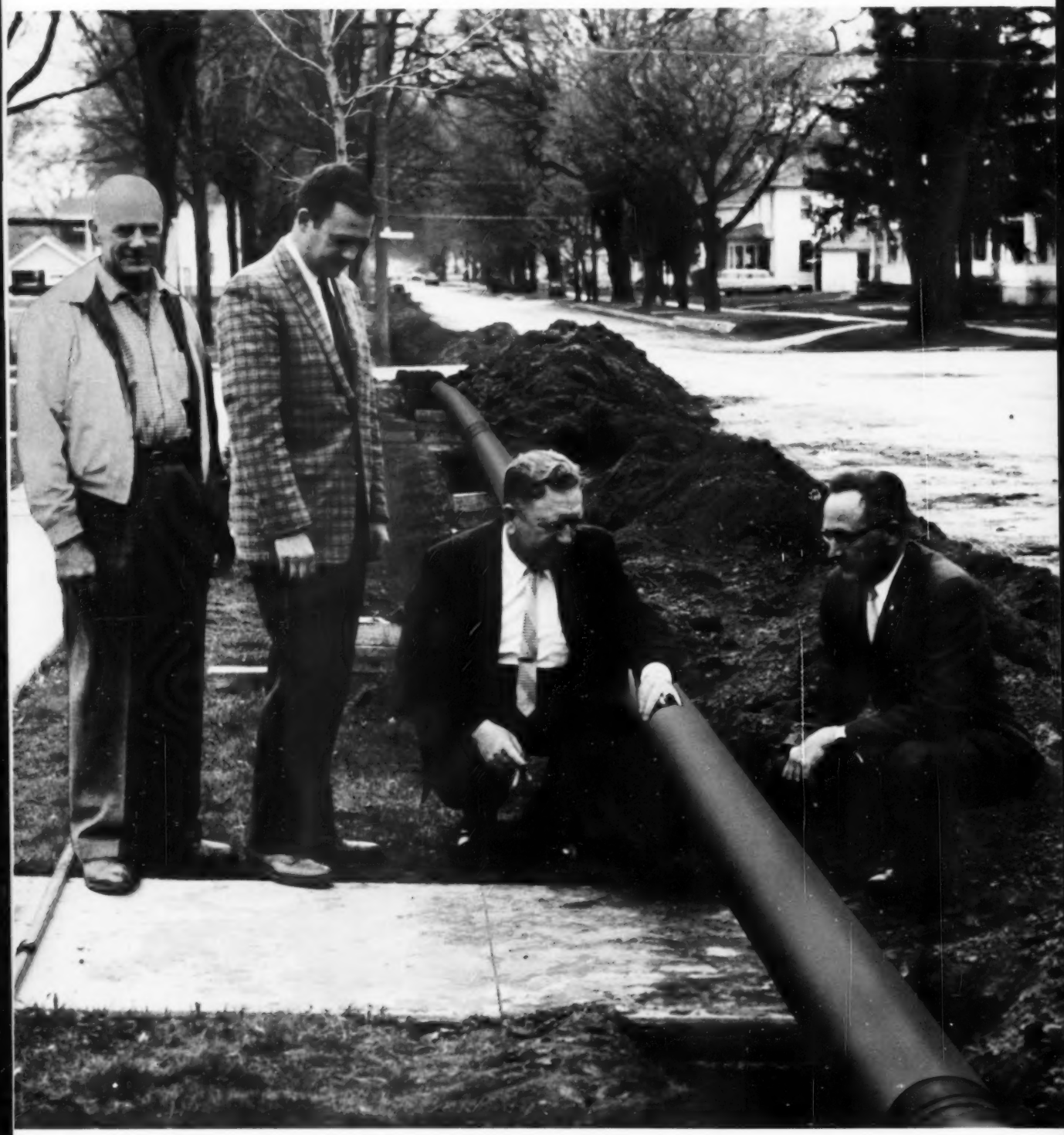
SUPERIOR METER DIVISION
NEPTUNE METER COMPANY
167–41st Street, Brooklyn 32, N.Y.

Branch Offices: Atlanta • Brooklyn
Chicago • Columbus • Dallas • Denver
Los Angeles • Louisville • North
Kansas City, Mo. • Philadelphia Area
(Bala-Cynwyd) • Portland
In Canada: Neptune Meters Ltd.
Toronto • Calgary • Halifax • Montreal
Vancouver • Winnipeg

X-TRU-COAT BRINGS GAS TO OSAGE

...contractor says,
"Best pipe I've ever installed!"

PRINCIPALS in the Osage installation, left to right, John Mathews, Panama Williams Company, contractors; Augie Stricker, consulting engineer; Mayor Urban Marr; Donald Stuart, consulting engineer. Not shown is Joseph E. Casey, Vice President of Carlton D. Beh Company, the underwriters of the revenue bonds used to finance the Osage system. Total of X-TRU-COAT Pipe, installed in 1" to 8" diameters, is expected to reach 180,000 feet.



After welding, X-TRU-COAT Pipe joints are primed and wrapped with X-TRU-TAPE, sealing out corrosion. When welds are completed, the pipe is pulled back, lowered, and slid under drives and walks without damage.

Strong, Modern, Dependable

Steel

X-TRU-COAT BRINGS GAS TO OSAGE

Citizens of Osage, Iowa, who until this year did not have the advantages of natural gas for cooking and heating, have good reason to be elated. Natural gas is coming to Osage! Carried to homes and industry via more than 34 miles of X-TRU-COAT Pipe, the natural fuel is expected to reduce heating costs at least 25%, and cooking costs by 50%. Mayor Urban Marr and his city council are elated too, at the success of their efforts to obtain this community improvement.

John Mathews, of Panama Williams Company, contractors installing the gas system in Osage, is elated for another and very different reason. He has this to say: "I've used X-TRU-COAT on many jobs and without a doubt it is the best pipe I've ever installed. It's very easy to handle and store, and you don't have to worry about heat or cold, coating breaks, or holidays."

Mr. Mathews says further that the Osage installation is typical of many installations, in that pipe must be slid through tunnels dug beneath driveways and sidewalks—and that he has found that X-TRU-COAT will not check, scratch, or tear, even in rocky soil. X-TRU-COAT's polyethylene plastic coating, in Mr. Mathews' words, "is there to stay." Even abuse in stringing or backfilling won't damage it.

All of which means that X-TRU-COAT will fully support Osage's efforts, and the efforts of any community, with savings in original installation and dependability in service—every foot usable when received—every foot easy to install, perfectly—every foot permanently sealed against corrosion and electrolytic action, for long, long service.

Republic is proud to have shared in bringing gas to Osage. If *you* are interested in a similar project, or if you are considering an industrial use of pressure carrying line pipe, call your Republic distributor. He can cite many case histories illustrating the remarkable durability and economy of X-TRU-COAT.

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

REPUBLIC STEEL CORPORATION
DEPT. G5-2698
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

☐ Please send . . . . reprints of "The Osage Story."
☐ Have a Republic distributor call.
☐ Please send literature on X-TRU-COAT Plastic Coated Steel Pipe.

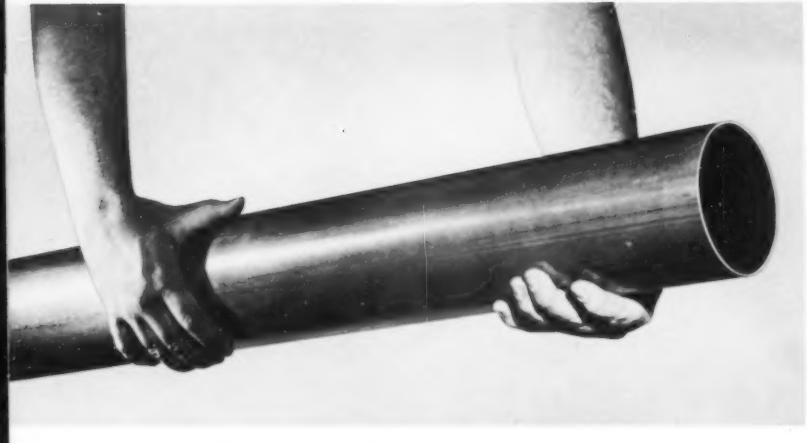
Name_____ Title_____

Company_____

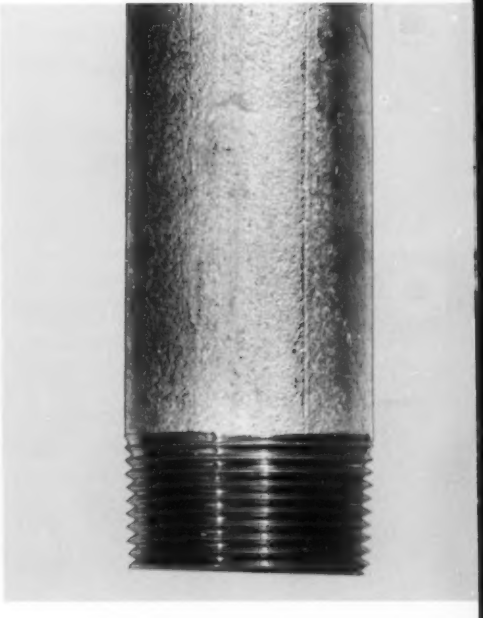
Address_____

City_____ Zone____ State_____

REPUBLIC SRK® PLASTIC PIPE has won big acceptance as "the pipe you can put in and forget." For gas, saltwater, and other corrosive materials, SRK resists every destructive action. Available in half-inch through eight-inch diameters, for a wide range of pressures.



REPUBLIC LIGHT WALL, the electric weld pipe that's ideal for gathering and distribution lines. Saves 1/3 the weight, 1/3 the cost. X-TRU-COAT is also available in light wall sizes. Meets applicable parts of API specification 5L . . . supplied in sizes from 1.315" through 4.500" O. D.



REPUBLIC STEEL PIPE, choice of operating men for tough jobs. Tight galvanized coating stubbornly resists corrosion damage. For water, gas, and steam systems—black and galvanized —delivered clean, rust-free, on time.

REPUBLIC STEEL CORPORATION
DEPT. GS-2698
1441 REPUBLIC BUILDING · CLEVELAND 1, OHIO

Please send literature on:

☐ Republic X-TRU-COAT ☐ Republic SRK Plastic Pipe
☐ Republic Light Wall Pipe ☐ Republic Steel Pipe

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

When you install services -use a REAL saddle!

Massive malleable iron construction. Hinged on one side. Single oversized plated bolt. Simplicity itself. Full contour contact—can't crush.

New "pillow" type neoprene gasket bonded inside cast retainer rings, preventing cold flow or blowing out under high pressure.

Each saddle pressure-formed to a perfect circle fit, soap-and-water tested. Write for special Folder SSS.

GEM

M. B. SKINNER CO.
South Bend 21, Ind.

SKINNER-SEAL SERVICE SADDLE

"Our Ford Trucks save us 2.3¢ per mile"

says Mr. R. M. Johnson, Vice President, Cosden Petroleum Corporation, Big Spring, Texas

"Our latest six-month truck operating expense summary shows that Ford Trucks cost only 8.6¢ per mile to run compared to 10.9¢ for our total truck fleet. This average covers all of our production, refining, marketing, pipeline and administration trucks. Since these figures include all maintenance and repair work, durability and reliability are two big factors that contribute to lower operating expense.

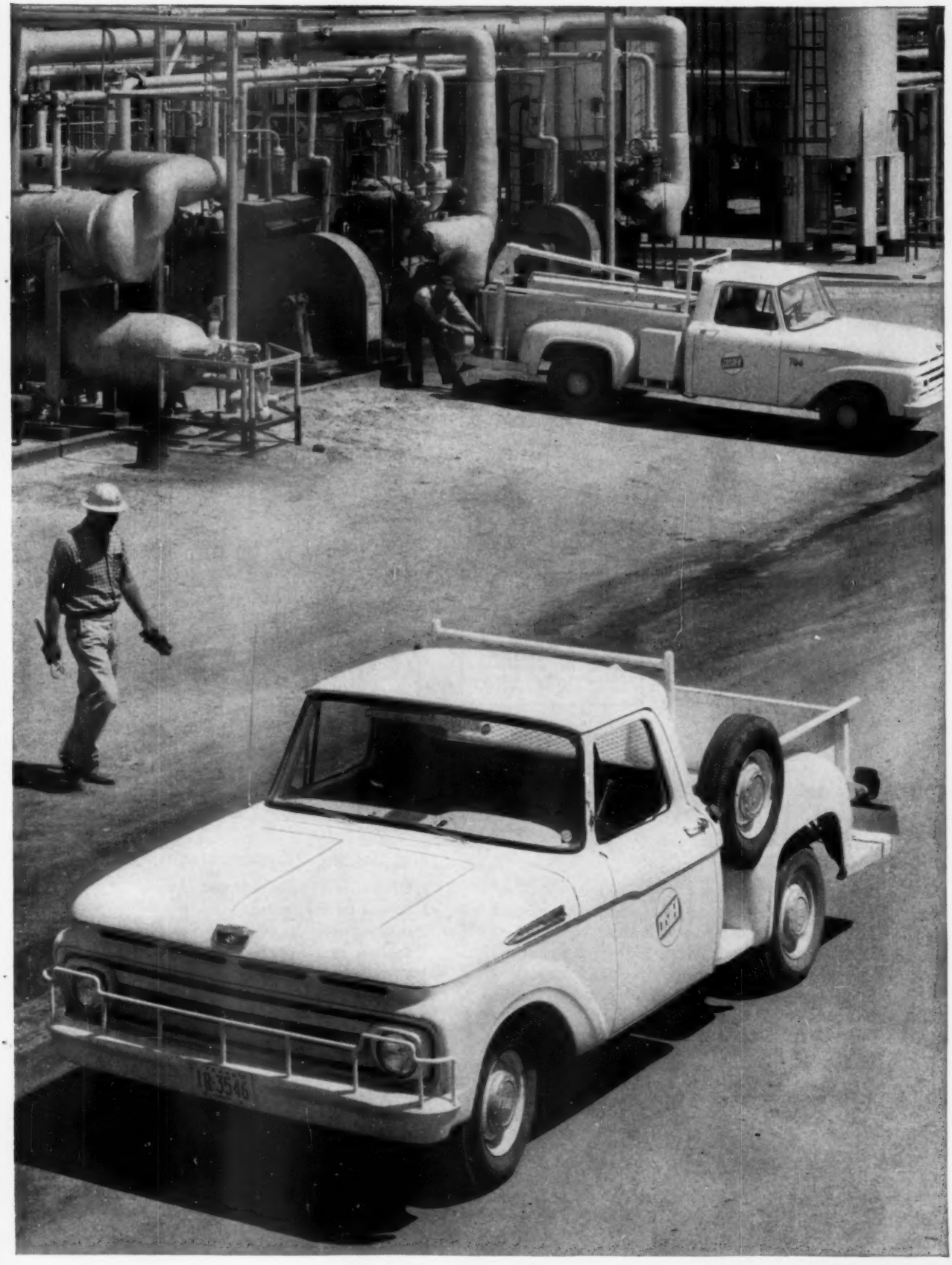
"Ford Trucks lead the fleet in these respects, too. A good case in point is our 1956 Ford F-800 winch truck. Its odometer reads just over 24,000 miles *but the engine has run an average of 7 hours a day, 5 days a week for the last 6 years.* Actually there are well over 8,000 hours on the engine so far, and without a major overhaul . . . this is service that we feel is the equivalent of 300,000 hard miles.

"Also, successive cost analyses have shown that we save money on maintenance and repairs by having all this work done at local Ford Dealer's. This system does away with our need for carrying an expensive parts inventory and reduces our own shop facility and manpower needs. Naturally, our 750 retail outlets do all the routine lubrication, washing and fueling for the fleet."

Solid testimony that Ford's full-time economy only starts with low price!

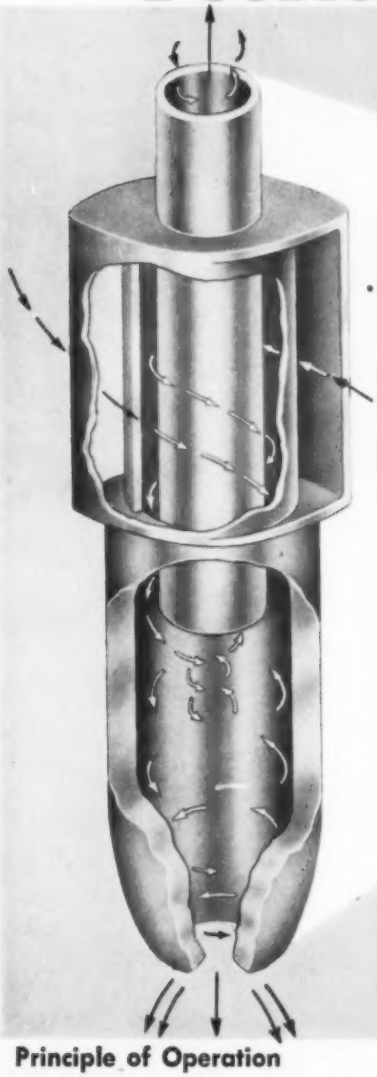
FORD TRUCKS COST LESS

PRODUCTS OF Ford MOTOR COMPANY

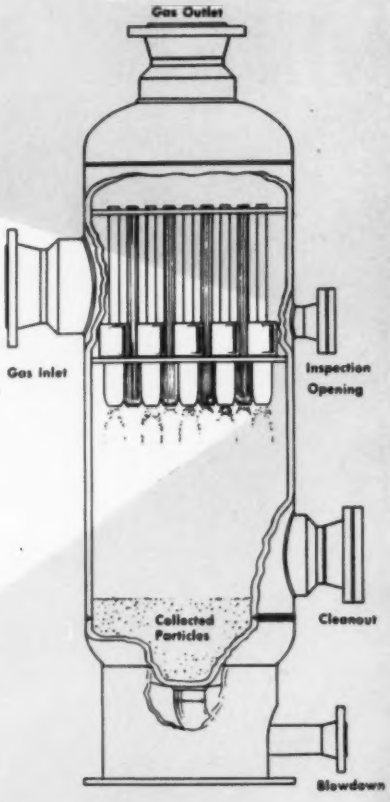


Another in a complete line of Peerless Scrubbers

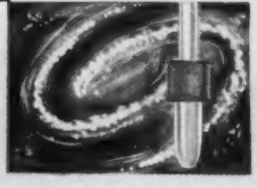
Peerless Dry Scrubber



. . . utilizes multiple cyclones to achieve high efficiency removal of troublesome dirt and liquid.



PEERLESS CYCLONE TUBE CONSTRUCTION . . .
The cyclone elements are constructed of an alloy combining abrasion and corrosion resistance with shock-resistant qualities needed for reciprocating compressor station requirements.



Principle of Operation

The Peerless Dry Scrubber consists of small diameter cyclones in parallel to provide the centrifugal force necessary for efficient small particle removal at high pressures. Peerless Dry Scrubbers are offered in a complete range of sizes and working pressures to fit any scrubber requirements. Also available are compartmented scrubbers to handle the problems of widely varying flows with only one vessel where multiple scrubbers have been required heretofore. Write for descriptive literature.

Provides these important advantages

1. Efficient removal of dust and liquids.
2. Cannot be overloaded.
3. Uses no scrubbing oil, hence no oil loss.
4. Requires no oil filling or settling tanks.
5. Virtually maintenance free, requiring only occasional blowdown of collected material.
6. Ordinarily smaller and less costly than wet type scrubbers.

Engineering Assistance Available: Peerless makes all types of Scrubbers, including Dry Scrubbers, Oil Bath, both a fixed contactor type (Swirl-Gas Cleaner) and a revolving contactor type (Scrubosphere). In addition, Peerless makes Gas Filters. Ask us for recommendations on the type Scrubber best suited to your application.

SEPARATORS: Liquid Vapor
DUST SCRUBBERS: Wet and Dry Types
GAS FILTERS
GAS ODORIZERS
SILLERS CLOSURES
OTHER PRODUCTS: Engine Timers, Scraper Traps, Manways

PEERLESS MFG. CO. DALLAS TEXAS

PEERLESS MFG. CO.

Representatives in All Principal Cities

P. O. Box 13165 • Dallas 20, Texas

Full protected by U. S. Patent 2931383.

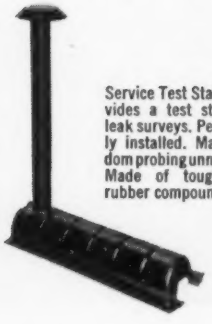
Easy to Locate

Leading gas utilities benefit every day with modern, permanent Handley Curb Boxes

Check the cost saving . . . time saving features of Handley Industries line of gas service equipment.

End call backs with attractive Handley outside meter boxes. Made of tough, resin-rubber compound*. Single meter cover shown. Models also available for double meter installation.

Roadway Valve Box. Designed to reduce the danger of vehicles damaging valves and gas mains. Constructed of tough resin-rubber compound, they telescope freely. Never rust. Never rot. Weight, only 9 lbs. each.



Service Test Station. Provides a test station for leak surveys. Permanently installed. Makes random probing unnecessary, Made of tough resin-rubber compound*.

Handley Cathodic Terminal Box. Landscape engineered and non-corroding*. Leads are attached to the terminal block in the cap for easy testing. Magnetic top for easy locating.

STRESS-FREE 7 TIMES LIGHTER

Leading utilities the country over are standardizing on Handley lifetime curb boxes for sound business reasons. Here are just a few . . .

- Handley curb boxes are easy to locate. A built-in magnet and aluminum plate makes them easy to find with either electronic or magnetic finders.
- Handley telescope design prevents damage to both piping and service stops.
- 7 times lighter than cast iron, they're easier to handle . . . easier to store . . . and easier to install.
- Constructed of a resin-rubber compound* they won't rust, or corrode, *and are free from electrolytic action*, and are built to last a lifetime.
- Fully assembled, light-weight Handley curb boxes are easier, faster, and safer to install. Cut installation costs.
- Handley curb boxes may be equipped with interchangeable cast-iron caps, if desired.

PROVE TO YOURSELF THAT HANDLEY CURB BOXES CAN PAY OFF IN GREATER EFFICIENCY AND ECONOMY FOR YOU. WRITE FOR THE FACTS TODAY.

HANDLEY INDUSTRIES, INC.

Phone State 9-6181 • 903 Belden Road • Jackson, Michigan

*A. B. S. Polymer

Provides trouble-free service for years

Decade after decade, cast iron pipe gets gas to where it's going—efficiently—trouble-free. Cast iron pipe rarely needs attention after installation.

It's a simple story of ruggedness.

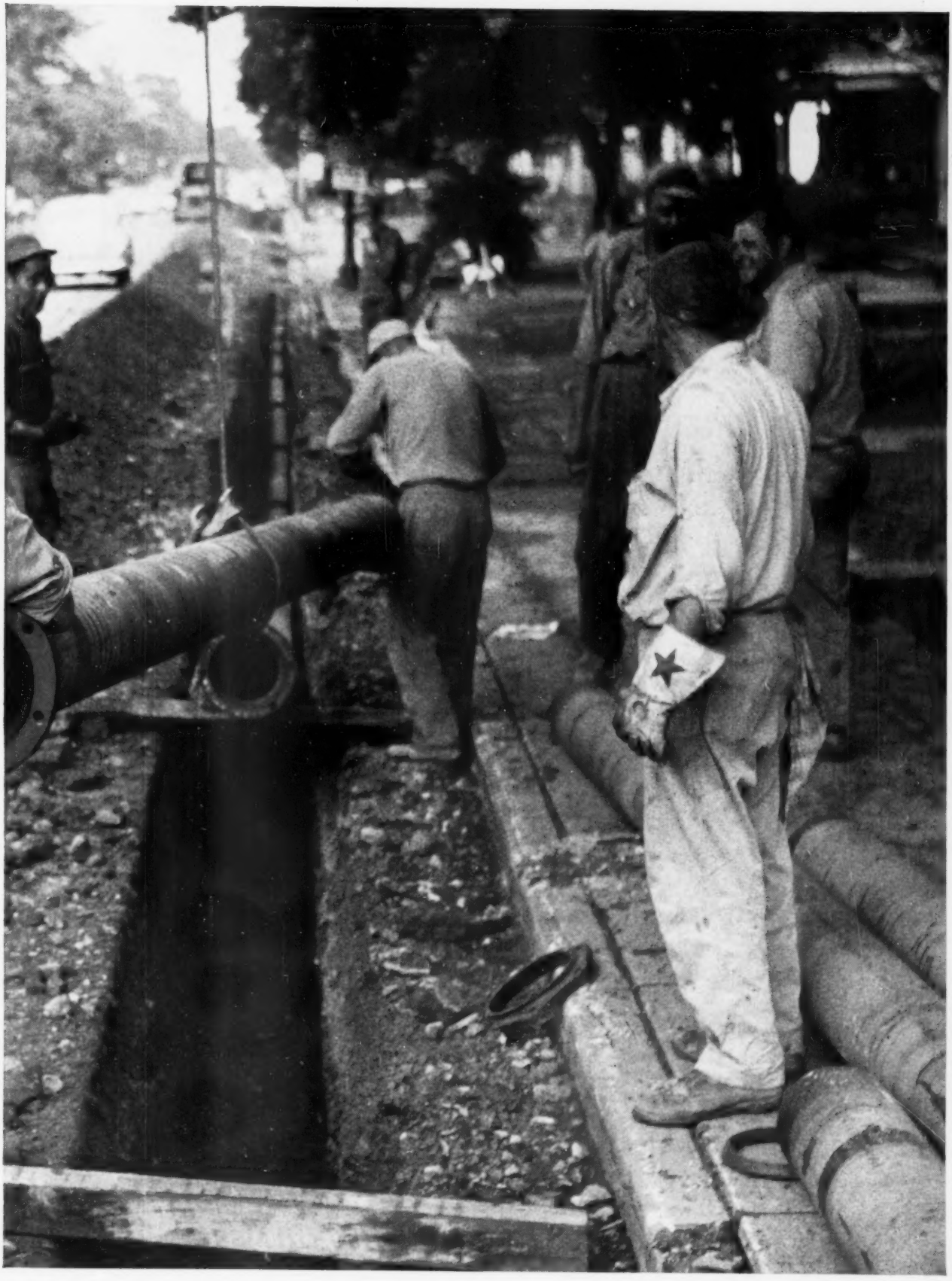
Rugged outside: cast iron pipe withstands all the usual stresses to which underground pipe is normally subjected.

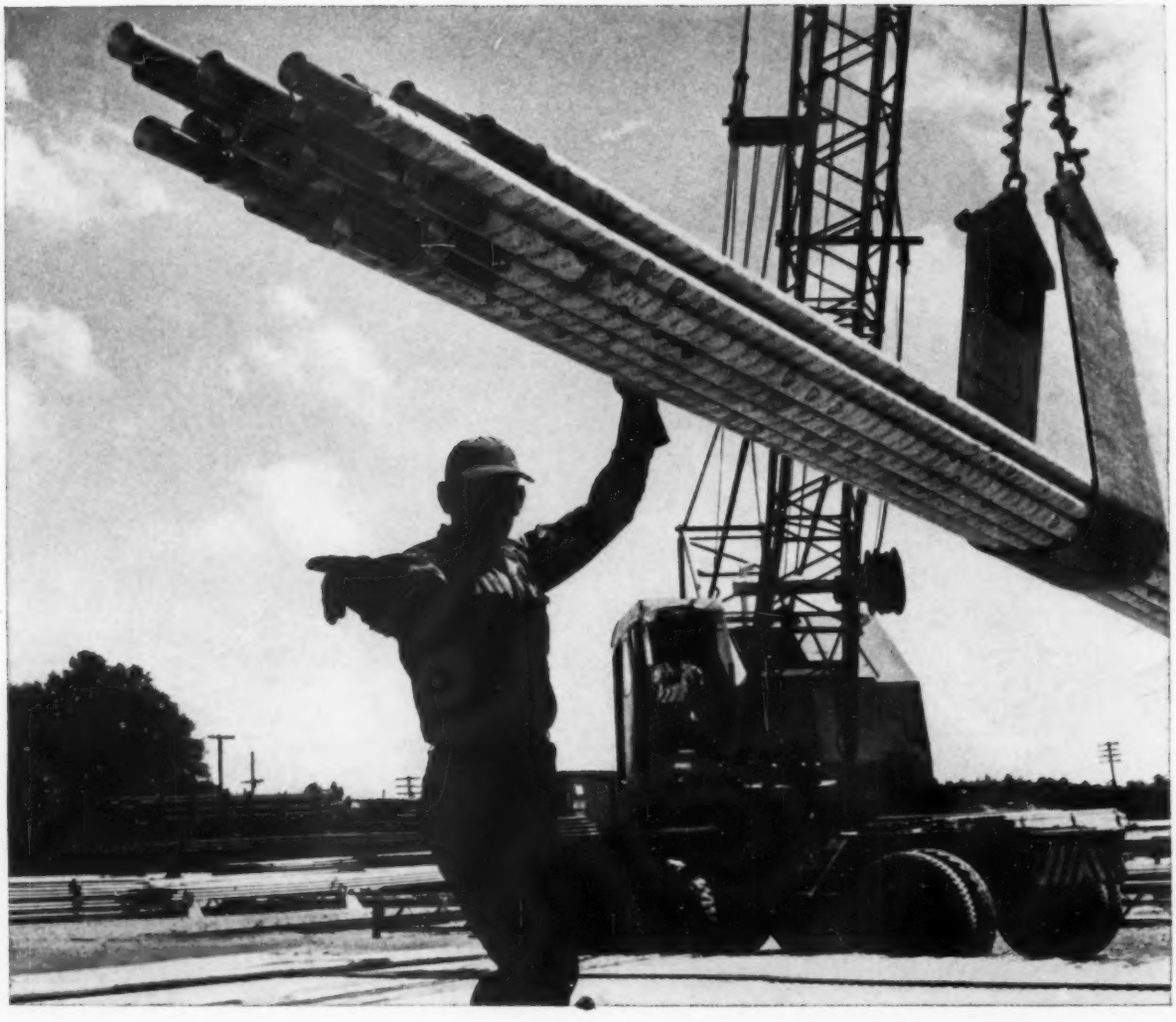
Rugged inside: bottle-tight mechanical joints remain tight under all normal distribution pressures.

And the ruggedness lasts. The cast iron gas mains you install today will still be operating when your great-grandchildren have grown up.

CAST IRON PIPE
THE MARK OF PIPE THAT LASTS OVER 100 YEARS

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director
3440 Prudential Plaza, Chicago 1, Illinois





Call Southern for pipe protection PLUS . . . job-site deliveries

What's the big reason to have your pipe coated and wrapped (or lined) at Southern Pipe Coating of Atlanta? It's the big "plus" you get in quality-control and speed of service.

Southern's modern all-weather plant and production lines, backed by skilled personnel and continuous quality control, can process pipe up to 30″ in diameter to your exact specifications. We can also handle special orders for coating and wrapping larger diameter pipe up to 80″ in diameter, to the same high standards of quality pipe protection.

Our truck fleet assures prompt delivery, and we can closely coordinate stringing along passable roads to meet your work requirements. If you wish, we can store your bare or processed pipe in our 24-acre plant at no cost to you.

See for yourself the only plant of its type supplying the majority of coated and wrapped pipe in the South. We'll gladly make all the arrangements for your visit. Or, if you're in the area, please drop in.

Southern Pipe Coating Company

795 PEACHTREE STREET, N. E. *ATLANTA, GA.*

It's a 3010... for heavyweight stability above ground... better work 13½ feet down

Built for the big jobs, the new John Deere "3010" furnishes a steady platform for fast, efficient trenching, plus the high mobility only a wheel tractor can provide.

Two John Deere backhoes are available for "3010" work—the center-mounted 50, and five-position 51 for regular and offset digging. Each operates with simple two-lever control, has a 13-1/2 foot digging depth.

With a "3010," the operator sees his job through from start to finish in comfort. Adjustable, weatherproof backhoe seat is contoured fiberglas plastic. Tractor seat is adjustable to operator's height and clean platform provides easy off-on access. Low profile improves stability.

The unit is available with a choice of power—64 engine h.p. gasoline or 69 engine h.p. Diesel. Power steering and power brakes are standard. Constant-mesh transmission.

For a "3010" demonstration, contact your John Deere equipment dealer now through the yellow pages. Ask him about the advantages of the John Deere Credit Plan, and long-term leasing arrangements available. John Deere, 3300 River Drive, Moline, Illinois.

JOHN DEERE

LOADERS
BACKHOES
SIDEBOOMS
AND
CONSTRUCTION
EQUIPMENT

K1534 4-Wheel Drive Pickup

R1254 Rampside Pickup

C1534 Fleetside Pickup

1962 CHEVROLET JOBMASTER TRUCKS ARE BUILT TO KEEP SAVING AND SAVING AND SAVING AND SAVING AND SAVING

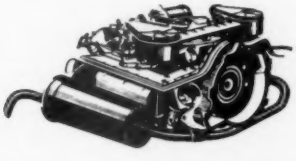
LOOK WHAT CHEVY'S GOT FOR '62...

MORE WAYS TO MAKE MORE MILES (AND MONEY)!

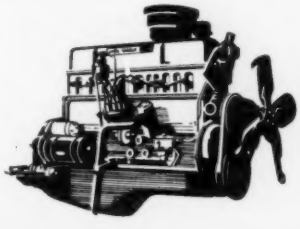
Matchless performers... matched to the job. That's what you'll find under the hoods of Chevrolet light-duty trucks for '62. More sure-saving power plants to choose from than ever before. New assurance of the *right* power for the job—power that does just what you want it to so that operating costs stay at a *low* low.

Standard in conventional models is the thrifty High Torque 235 Six, an engine that's powered more payloads than any other. *Then for heavier, harder working jobs that take more out of a truck, Chevy offers two great optional (extra-cost) engines for '62: the big High Torque 261 Six, available for the first time in this weight class, and the spunky High Torque 283 V8 with short-stroke design.*

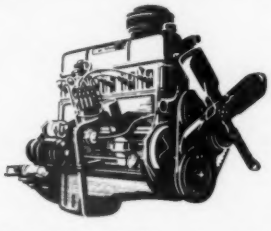
Add to this engine spread the space-saving High Torque 145 Six provided in Corvair 95 models and you've got a broad, all-purpose lineup that allows you to match the power to your type of work and nurse the last penny's worth of performance out of every operating dollar. Talk it over with your Chevrolet dealer soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.



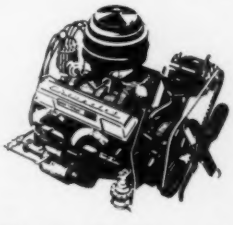
Compact High Torque 145 Six—air-cooled "pancake" design (only 17" high) saves space and minimizes weight by eliminating water jacketing, radiator, coolant and water pump. Gone for good are antifreeze and cooling system maintenance expenses. With fuel-saving valve-in-head design, the 145 Six develops 80 hp and 128 ft.-lbs. of torque—ample for brisk performance with big loads.



Rugged High Torque 261 Six—you get extra torque (235 ft.-lbs. of it) for extra tough pulls, *plus* proved 6-cylinder economy—available for the first time in Chevrolet light-duty trucks. Provides 150 hp and scores of reasons for efficient, cost-saving performance—forged steel crankshaft, high-alloy inlet valves, precision bearings, hard-faced exhaust valves with Rotocoils, to name just a few.



Popular High Torque 235 Six—the most widely used engine in the history of hauling with 235 cubic inches of lean-muscled efficiency. Standard in conventional models, the 235 Six delivers 135 hp and a load-moving 217 ft.-lbs. of torque. Premium-quality features such as forged steel crankshaft, aluminized exhaust valves, oil-bath air cleaner, and precision bearings add to engine durability.



Efficient High Torque 283 V8—made to order for runs that call for the extra punch of V8 power. Advanced short-stroke design knows how to nurse extra power and miles out of every drop of gas. 160 hp and 270 ft.-lbs. of torque get big loads moving quickly and efficiently. Top durability features include chrome-plated piston rings, Moraine 100 bearings and hydraulic valve lifters.

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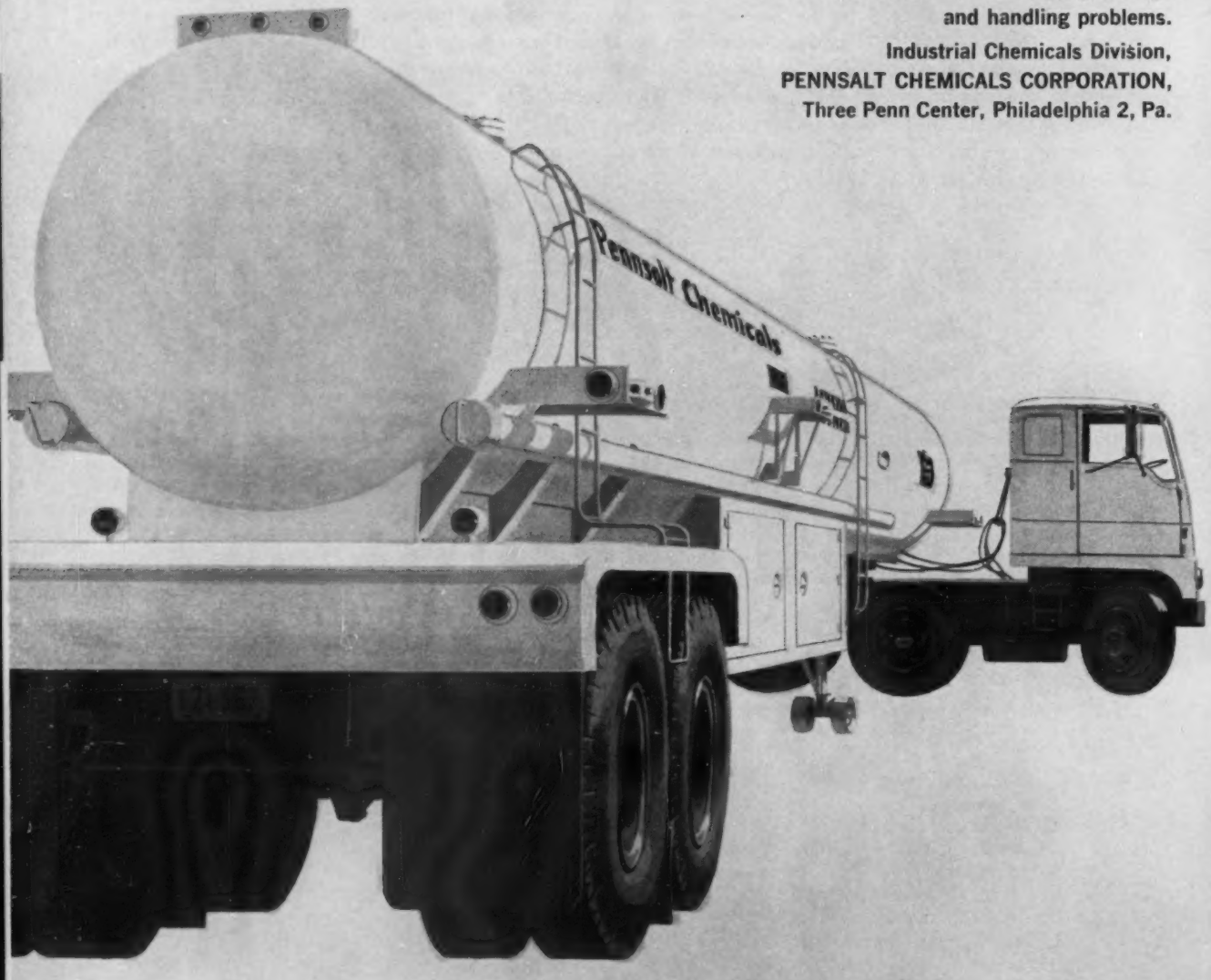

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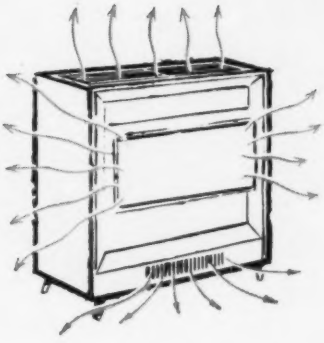

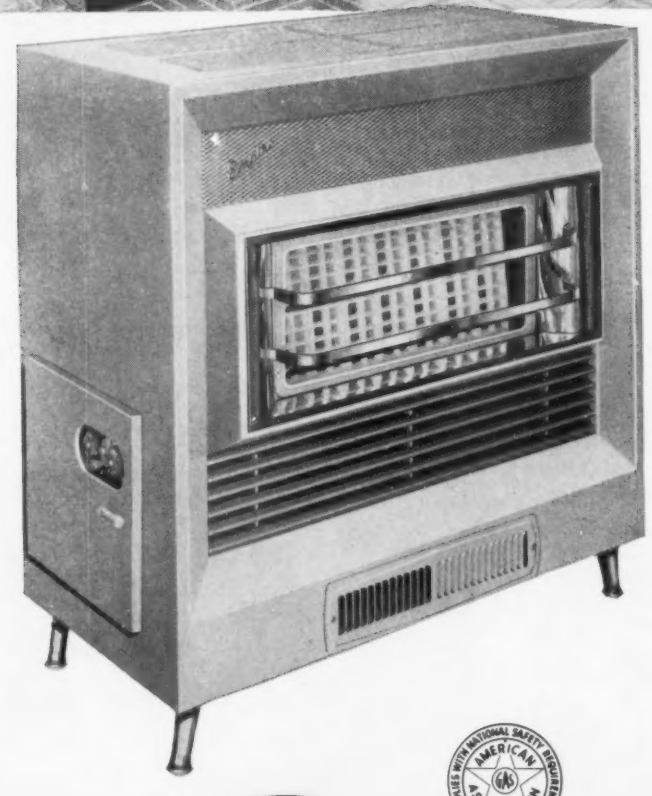

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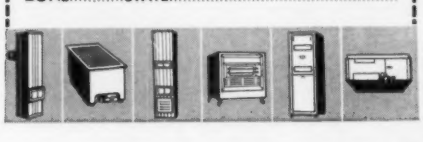

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Model 310. Here is the easiest-operating crawler tractor on the market. You can hop right in from a rubber-mounted rig and feel "at home".

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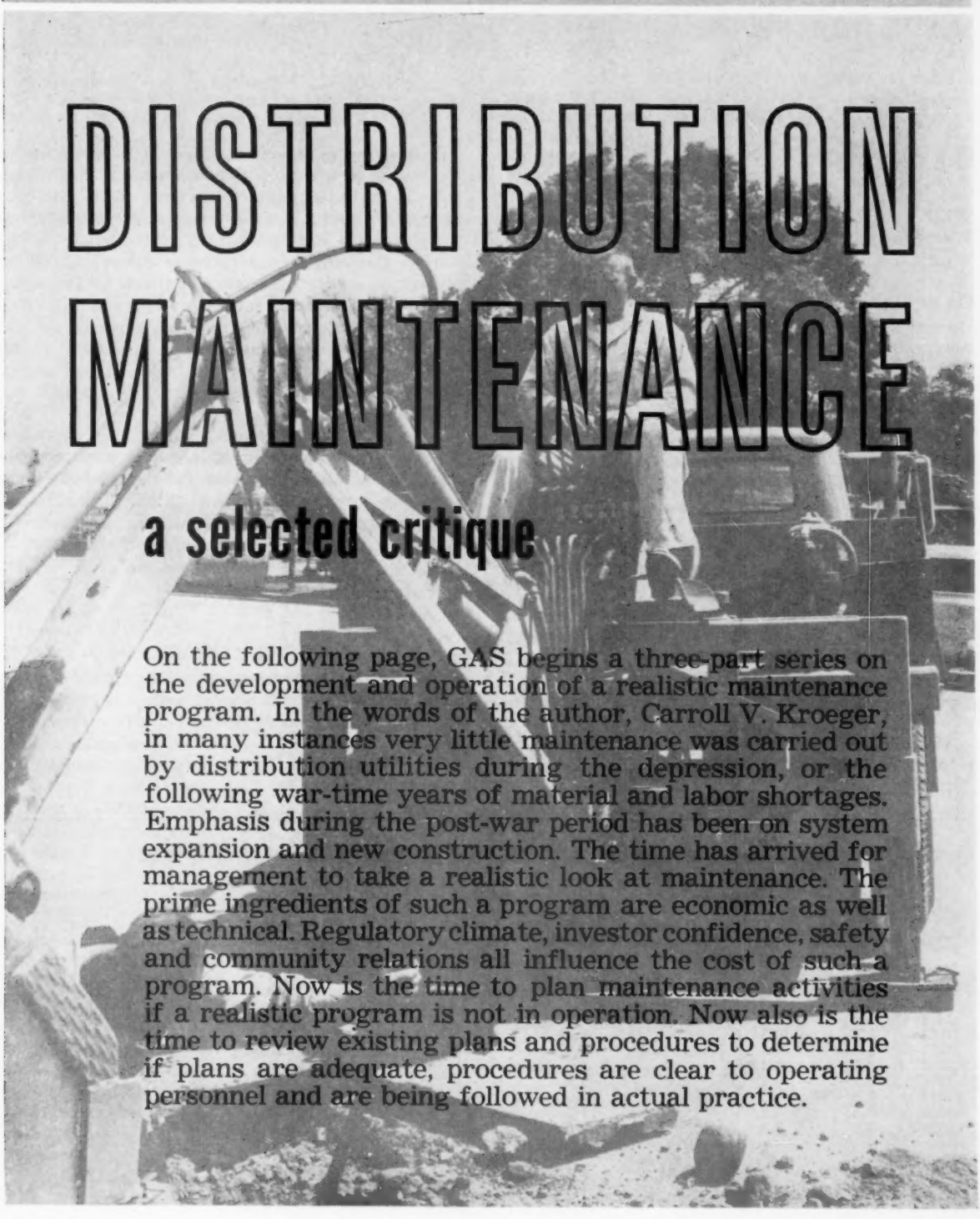


DISTRIBUTION MAINTENANCE

a selected critique

On the following page, GAS begins a three-part series on the development and operation of a realistic maintenance program. In the words of the author, Carroll V. Kroeger, in many instances very little maintenance was carried out by distribution utilities during the depression, or the following war-time years of material and labor shortages. Emphasis during the post-war period has been on system expansion and new construction. The time has arrived for management to take a realistic look at maintenance. The prime ingredients of such a program are economic as well as technical. Regulatory climate, investor confidence, safety and community relations all influence the cost of such a program. Now is the time to plan maintenance activities if a realistic program is not in operation. Now also is the time to review existing plans and procedures to determine if plans are adequate, procedures are clear to operating personnel and are being followed in actual practice.

Tools of economic analysis

HOW can a utility investor, a utility commission or a utility management determine whether gas distribution maintenance expenses are reasonable? What constitutes a realistic maintenance program? Where is the proper balance in maintenance between what is technically desirable and economically feasible? Whether the individual asking such questions is an investor, a consumer, an employee or a member of management, the cost of gas distribution maintenance programs and the safety condition of distribution facilities are subjects worthy of constant review.

THE COST VIEWPOINT

The utility manager is interested in costs because the mission of management is to minimize losses, maximize profits, and perpetuate the enterprise. The management functions in carrying out its mission are threefold:

(1) Planning—identification of objectives to be accomplished and programming the means of reaching the objectives.

(2) Financing—securing the necessary funds required by the plans, and exercising control over their disbursement.

(3) Execution—training and assignment of manpower, work direction and leadership, and evaluation of results with objectives.

The security analyst and utility investor are interested in costs because it is the investor funds which will finance the enterprise. They will determine to the best of their ability that their monies, if invested, will be protected against loss, and that they will receive an adequate return on their investment in relation to the risk involved.

Since the business enterprise is a regulated public utility, the utility commission also will be interested in costs. The commission has the responsibility of protecting the interests of the consumer and general public. A regulatory commission is justified in reducing or eliminating expenses traceable to inefficiency. This never is done without a hearing and sufficient evidence.

A security analyst, commission member, or utility manager is interested in maintenance costs because they are a revenue deduction and directly affect net operating income. The typical utility income statement lists operating revenue deductions as follows:

Operations
Maintenance
Depreciation
Federal taxes
General taxes

Every dollar of revenue deductions offsets a dollar of gross revenues. Excessive costs are subject to question by the shareholder and utility commissions since they may arise through lax management or inefficient operations. If costs are not reasonable, the

TABLE 1. Maintenance Ratios for Straight Natural Gas Distribution Companies

Year	Production	Storage	Transmission	Distribution	Customers Collecting and Accounting	Sales Promotion	Administrative and General	Total Maintenance	Distribution Maintenance as % of Total Maintenance
1950	0.5	0.2	—	5.5	—	—	0.3	6.5	84.6
1951	0.4	0.1	0.1	5.8	0.1	—	0.3	6.8	85.3
1952	0.6	0.1	0.2	5.9	—	—	0.3	7.1	83.1
1953	0.9	0.1	—	6.7	—	—	0.4	8.1	82.7
1954	0.8	0.1	—	5.9	—	—	0.3	7.1	83.1
1955	0.7	0.1	—	5.8	—	—	0.3	6.9	84.1
1956	0.7	0.2	0.1	6.0	—	—	0.3	7.3	82.2
1957	0.6	0.1	—	5.5	—	—	0.3	6.5	84.6
1958	0.5	0.1	—	4.7	—	—	0.2	5.5	85.5
1959	0.5	0.1	—	5.0	—	—	0.3	5.9	84.8
Ten-Year Average	0.62	0.12	0.04	5.7	0.01	—	0.3	6.8	83.8

Source: AGA "Historical Statistics of the Gas Industry" and "Gas Facts."

A selected critique
By Carroll V. Kroeger,
Senior Gas Engineer,
Stone & Webster Service Corp.,
New York

consumer may be required to pay an unfair rate for service, or the shareholder may be deprived of a fair return on his investment. Cutting across the grain of these interests in costs is a paramount concern by all for public safety.

The usual treatment of operating expenses is by segregation into the following classifications:

Production
Transmission
Distribution
Customer accounting and collecting
Sales promotion
Administrative and general

According to American Gas Association statistics, in 1959 distribution system maintenance costs constituted 5.9 per cent of total operating expenses and 84.8 per cent of all maintenance for straight natural gas distributing companies (excluding transmission and combination companies). These compare with a 10-year average of 5.7 per cent of total expense and 83.8 per cent of total maintenance *(Table 1)*. It can be seen that virtually all of the maintenance expense of a straight natural gas distributing company is in distribution system maintenance.

DEPRECIATION

Any discussion of maintenance must of necessity touch upon depreciation. A realistic maintenance program will limit depreciation requirements by minimizing the effects of the cause of depreciation. In gas utility accounting the dividing line between maintenance and depreciation is determined by the uniform system of accounts. Maintenance units as defined in the uniform system of accounts are listed in *Table 2*. Depreciation means "the loss in service value not restored by current maintenance, incurred in connection with the consumption or prospective retirement of utility plant in the course of service from causes which are known to be in current operation and against which the utility is not protected by insurance. Among the causes to be given consideration are wear, tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, changes in demand and requirements of public authorities, and in the case of natural gas companies, the exhaustion of natural resources."

The serviceability and usefulness of utility plant can be maintained by repair and replacement even though usage and action of the elements result in gradual physical deterioration. Inadequate maintenance will hasten the time of retirement, but an adequate maintenance program can prevent the premature demise and in many instances prolong plant life for an indefinite period of time. Adequate maintenance has been called "that degree of maintenance which is most economical or otherwise most advantageous as a matter of good business management."

EXPENSE RATIOS

How can maintenance and depreciation costs be analyzed? One approach is by the use of expense ratios whereby the costs of a number of companies are compared. AGA statistics for 1959 show that for straight natural gas distributing companies maintenance expenses averaged 4 per cent of operating revenues, and that depreciation expenses were 4.7 per cent of operating revenues. For the same period maintenance expenses were 2 per cent of total plant and depreciation comprised 2.4 per cent of total plant. *Table 3* lists these ratios for the 15-year period 1945

TABLE 2. Maintenance Items

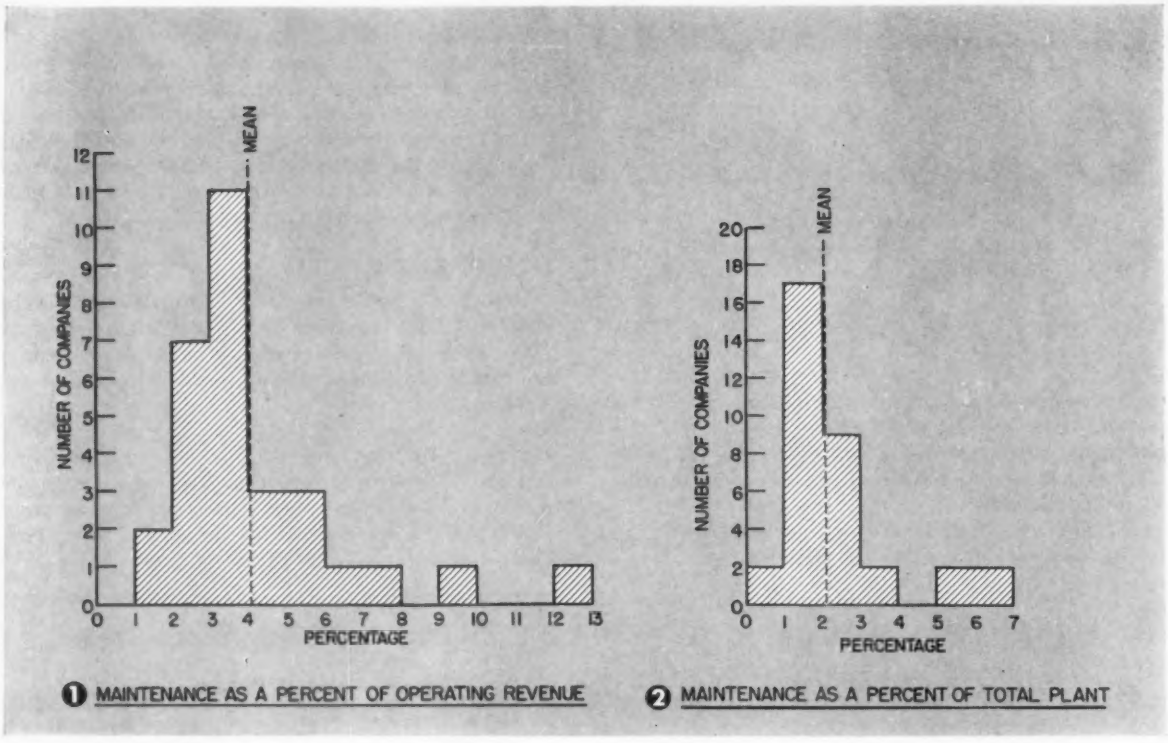
1. Direct field supervision of maintenance.
2. Inspection, testing, and reporting on condition of plant specifically to determine the need for repairs, replacements, rearrangements and changes and inspecting and testing the adequacy of repairs which have been made.
3. Work performed specifically for the purpose of preventing failure, restoring serviceability or maintaining life of plant.
4. Rearranging and changing the location of plant not retired.
5. Repairing for reuse materials recovered from plant.
6. Testing for, locating and clearing trouble.
7. Net cost of installing, maintaining, and removing temporary facilities to prevent interruption of service.
8. Replacing or adding minor items of plant which do not constitute a retirement unit.

Source: NARUC Uniform System of Accounts for Class A and B Gas Utilities 1958.

TABLE 3. Maintenance and Depreciation Ratios—Straight Natural Gas Distribution Companies

	Maintenance as % of		Depreciation as % of	
Year	Operating Revenues	Total Plant	Operating Revenues	Total Plant
1945	2.3	1.3	3.6	2.0
1946	2.8	1.6	3.7	2.1
1947	3.7	2.0	4.3	2.3
1948	4.9	2.4	5.6	2.7
1949	4.9	2.5	5.1	2.6
1950	4.4	2.2	5.2	2.6
1951	4.6	2.4	4.5	2.4
1952	4.9	2.4	4.9	2.4
1953	5.6	2.7	5.6	2.6
1954	5.1	2.5	5.3	2.6
1955	4.8	2.3	5.1	2.5
1956	4.9	2.5	5.0	2.5
1957	4.5	2.2	5.1	2.5
1958	4.3	2.2	4.9	2.5
1959	4.0	2.0	4.7	2.4
Fifteen-Year Average	4.4	2.2	4.8	2.5
Ten-Year Average	4.7	2.3	5.0	2.5

Source: AGA "Historical Statistics of the Gas Industry" and "Gas Facts."



❶ MAINTENANCE AS A PERCENT OF OPERATING REVENUE

❷ MAINTENANCE AS A PERCENT OF TOTAL PLANT

through 1959 and gives the 10- and 15-year averages.

It should be noted that these ratios will vary considerably from company to company depending upon the nature of the individual company loads and operating characteristics. To illustrate this variation, a compilation was made of 31 investor-owned gas distribution companies, each serving over 10,000 customers. Transmission and combination companies were excluded. The selection was based upon those companies whose financial and operating data were available in the 1960 issues of Moody's Public Utility Manual and Brown's Directory of American Gas Companies. The geographical distribution of the selection was as follows:

New England States	6 companies
Southern States	10 companies
Central States	9 companies
Eastern States	4 companies
Western States	2 companies
Total	31 companies

The compilation was not intended necessarily to be representative of the industry. It is interesting to note, however, the comparison of maintenance and depreciation ratios with the AGA statistics:

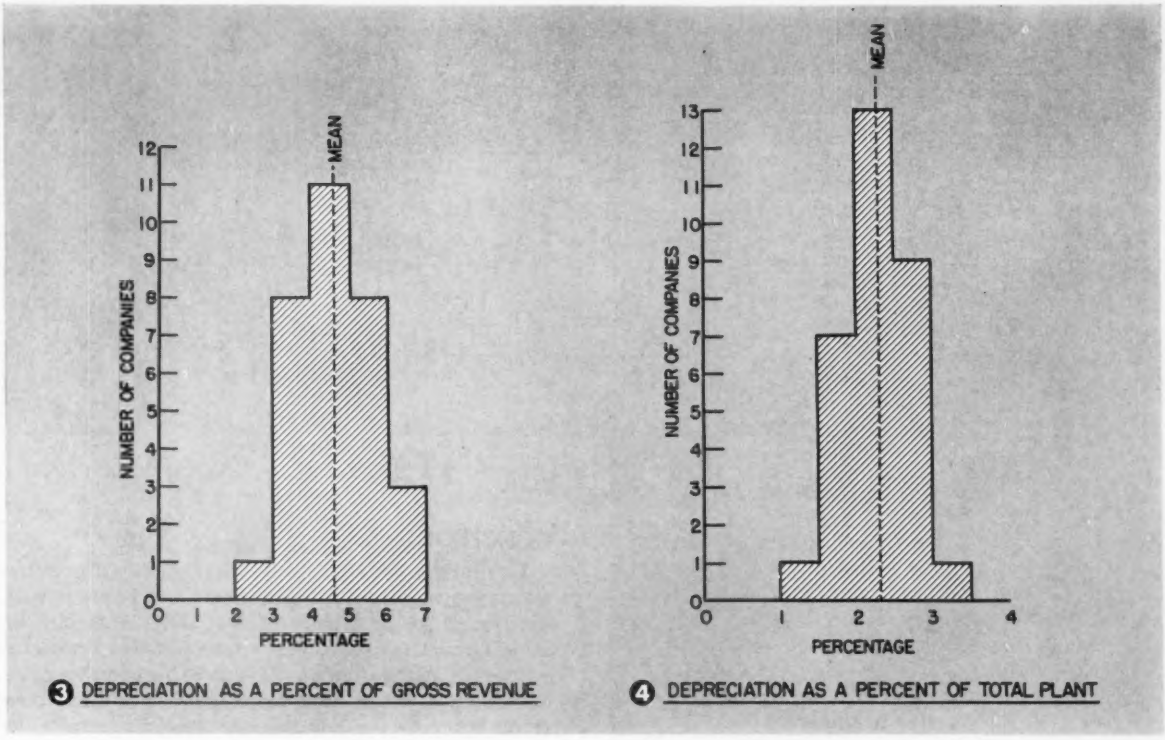
	AGA	*31-Company Average*
Maintenance as % of operating revenue	4.0	4.05
Maintenance as % of total plant	2.0	2.0
Depreciation as % of operating revenue	4.7	4.6
Depreciation as % of total plant	2.4	2.3

The statistical study included a total of 5,368,000 customers. The companies range from the smallest of 11,000 customers to the largest with 1,145,000 customers. Groupings of companies by customer size were as follows:

10,000 to 50,000	10 companies
50,000 to 100,000	10 companies
100,000 to 500,000	8 companies
500,000 to 1,000,000	2 companies
Over 1,000,000	1 company
Total	31

Fig. 1 illustrates the variation between companies of maintenance expenses as a per cent of gross operating revenues. The lowest was 1.5 per cent compared to a high of 12.1 per cent. The overall average was 4.05 per cent and 11 of the 31 companies had ratios between 3 per cent and 4 per cent. A comparison of maintenance as a per cent of total plant is given on *Fig. 2*. The highest individual company percentage was 6.9 per cent and the low was 0.8 per cent. These compare with the overall average of 2 per cent. Seventeen of the total companies had a ratio of between 2 and 3 per cent.

Fig. 3 gives the ratio summary of depreciation to gross operating revenues. The individual high was 6.5 per cent compared to a low of 2.7 per cent. The entire group average was 4.6 per cent with 11 companies falling in the 4 per cent to 5 per cent range. Depreciation related to total plant is shown on *Fig. 4*. The individual company high was 3.4 per cent and the low was 1.8 per cent. These compare to the group aver-

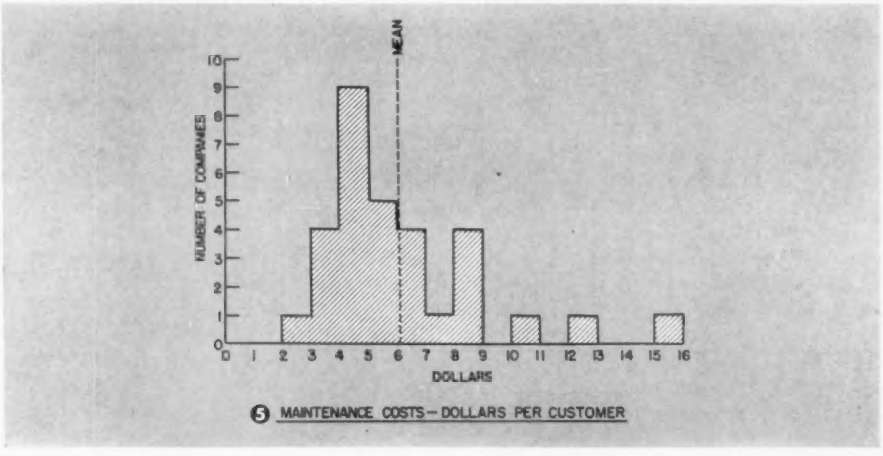

MEAN
NUMBER OF COMPANIES
PERCENTAGE
0 1 2 3 4 5 6 7
0 1 2 3 4 5 6 7 8 9 10 11 12
MEAN
NUMBER OF COMPANIES
PERCENTAGE
0 1 2 3 4
0 1 2 3 4 5 6 7 8 9 10 11 12 13

3 DEPRECIATION AS A PERCENT OF GROSS REVENUE

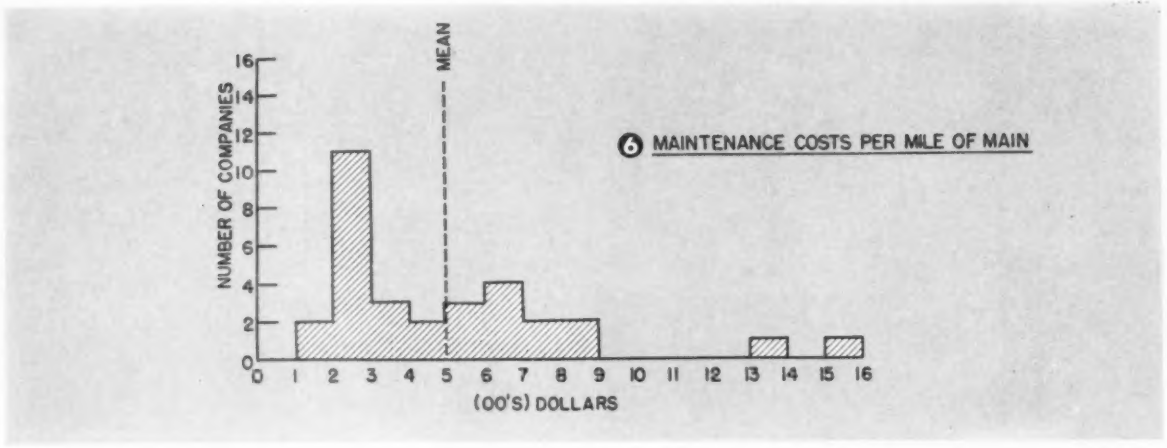
4 DEPRECIATION AS A PERCENT OF TOTAL PLANT

age of 2.3 per cent. Thirteen companies were grouped together in the 2.0 per cent to 2.5 per cent range.

Because of the individual differences in operating conditions, other maintenance ratios also were calculated. *Fig. 5* gives the maintenance costs in dollars per customer. The individual company low was $2.72 and the high was $15.44 per customer. These compare with the 31-company average cost of $6.11 per customer. Nine companies' costs were within the range of $4 to $5 per customer. Unit costs per customer for maintenance expenses can be misleading because of differences in size of system required to serve customers, age of systems, load characteristics, etc. For instance the company with the lowest unit maintenance cost per customer serves 16,000 customers through 161 miles of main in a western state. During the three-year period 1956-1959 it experienced a 14 per cent increase in customer growth and an 18 per cent increase in miles of distribution main. It compares with an older eastern company with the highest unit costs serving about 35,000 customers. During the comparable three-year period this older company experienced a loss in customers of about 1 per cent but grew in distribution mains by almost 4 per cent. The amount of main to be maintained by the eastern company is almost three times that of the western com-



5 MAINTENANCE COSTS—DOLLARS PER CUSTOMER



6 MAINTENANCE COSTS PER MILE OF MAIN

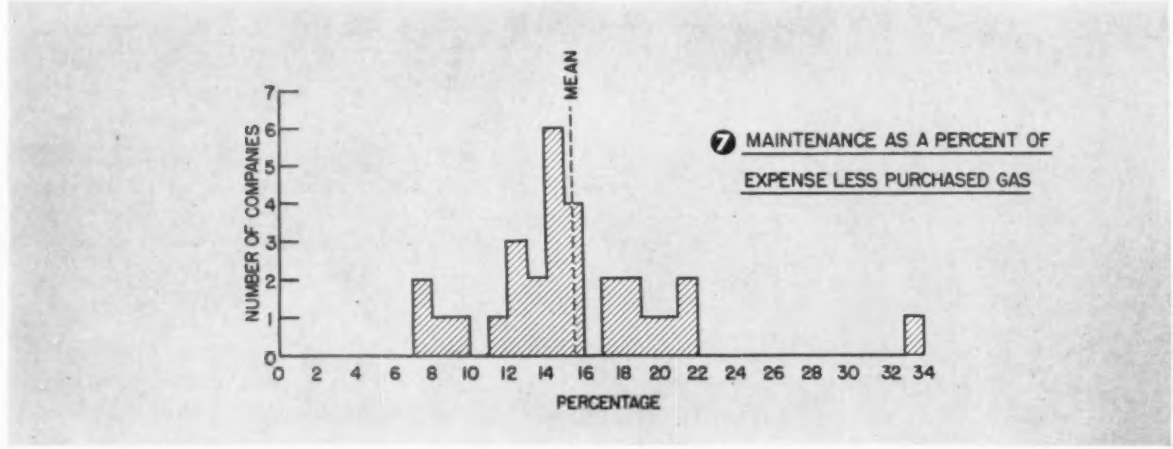
pany to serve two times the number of customers. The cost of maintenance of the eastern company was about $550 per mile of main compared to $200 per mile of main for the western company. Cost distribution of companies for maintenance per mile of main is shown on *Fig. 6*. Lowest individual company cost was $185 per mile compared with a high of $1,577 per mile. The 31-company average was $498 per mile. Eleven of the total number of companies fell into the $200-$300 per mile range.

Since purchased gas costs are the major expense item in a natural gas company operation, a ratio was computed relating maintenance costs to total expenses less the cost of purchased gas. Because the cost of purchased gas was not available for two of the companies, these ratios apply to 29 of the companies with one company from the New England states and one company from the central states deleted from the grouping. The lowest ratio for the group was 7.5 per cent and the high was 33.5 per cent. Overall 29-company average was 15.4 per cent with the largest grouping of six companies falling into the 14 per cent to 15 per cent range.

CONCLUSION

Limitations of ratio analysis are to be recognized since comparative statistics should not be used without regard for or a knowledge of differences in operating circumstances. Comparisons between companies without consideration of differences in operating conditions thus would have less significance than those ratios covering a single company record over a period of years. These ratios, however, are the tools of analysis, and give a point of departure for further questioning and discussion.

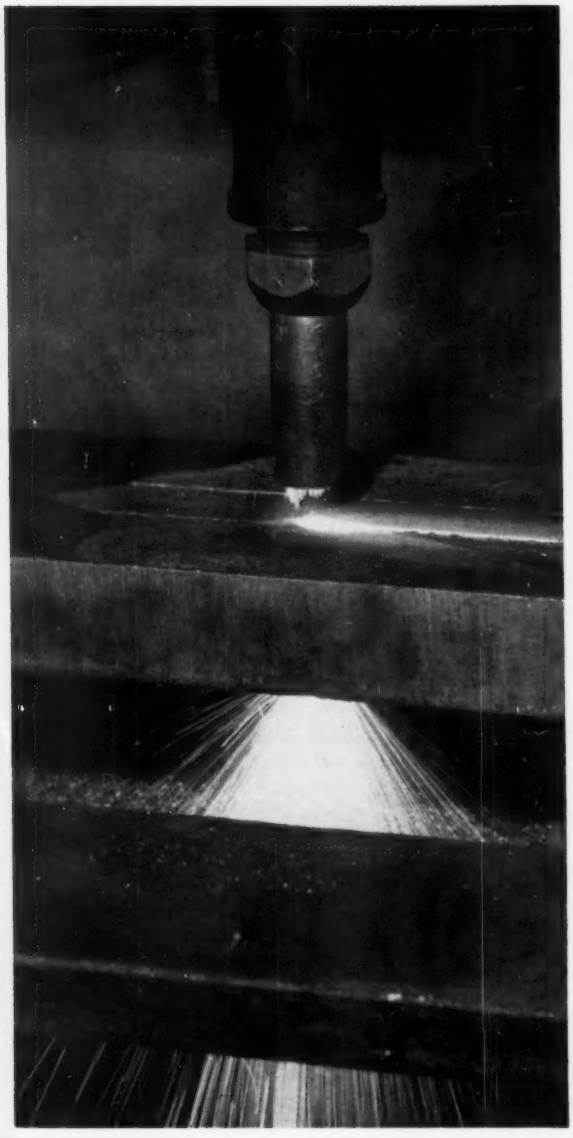
Ratio analysis, then, establishes the guideposts or reference points for management, investor, and utility commission. It forms the point of departure for detail review of the individual company's operating and maintenance practices. Ratios may reveal if a company's costs are reasonable. They cannot tell if those costs are adequate or determine whether a maintenance program is realistic. Ratios may serve as a measure as to what is economically feasible for maintenance expense. However, they cannot reveal the relative safety or hazard conditions that are so important in the operation of a gas distribution system. ■



7 MAINTENANCE AS A PERCENT OF EXPENSE LESS PURCHASED GAS

Gas cuts costs for structural steel fabricator

By R. M. Austin



The Acetegen three-piece tip was found by Pacific Car's technicians to solve many cutting problems when using natural gas. The extra half row of pre-heat orifices, indicated by longer flame on left-hand side of tip, makes it possible to cut at a rate comparable to acetylene.

THE extensive reduction in operating costs which structural steel fabricating plants can realize by converting from acetylene to natural gas for burning and heating was recently demonstrated in dramatic manner by the Structural Steel division of the Pacific Car & Foundry Co. of Seattle. As the result of a transition to natural gas, the company reports, plant overhead will be reduced more than $6000 annually.

Pacific Car's transition project is of significance to natural gas utilities, not only as an indication of the excellent industrial market which exists in this field. It also stresses the need for thorough study of the means by which natural gas can be adapted to serve the new technology which has come to the structural steel industry with the advent of space age metals.

The interest of the company's officials in the possibilities of changing to natural gas was stimulated by a need for reducing overhead expenses because of the narrowing profit margins resulting from the highly competitive nature of the industry. The division has long produced acetylene in generators at the plant site, and while this system was satisfactory for burning, it did not supply sufficient fuel for the use of large torches in heating and shrinking.

First interest in the possibility of converting resulted from a suggestion by representatives of the Washington Natural Gas Co. in Seattle. They pointed out that an old gas main—which hadn't been used in years—ran into the plant. By using this main, a switchover to natural gas could be accomplished with a minimum of difficulty and would result in large savings.

Fred L. Burr, assistant purchasing agent of the division, was then assigned the task of determining the advantage of using natural gas in the plant and projecting a cost summary.

"In looking for source material on which to base my report, I soon learned that the technology of burning and heating in a structural steel fabricating plant is far more complex than for such commonplace applications as burning in junkyards, etc." Burr said. "Due to the fact that there was no previous installation of this nature which I could study, all of the groundwork had to be done through extensive research before I could accurately appraise all aspects of a natural installation in our plant," he added.

It took Burr several months to complete his survey, working on this project in addition to his other duties. But the time was extremely well spent. It not only proved the advisability of converting to natural gas, but revealed that extensive savings were possible with natural gas. Furthermore, his report stated, the transition would make 160 Mcf of natural gas available monthly for space heating—and at no additional cost as this would be the balance remaining from the monthly supply of 200 Mcf.

Eager to take advantage of these impressive savings and satisfied that natural gas would prove acceptable from the technical standpoint, Pacific Car's management authorized an appropriation of $5000 for the transition. A committee, consisting of Burr, Henry G. Frye, a welding technician, and Russell E. Norris, a maintenance specialist, was formed to implement the program.

In planning the system, Pacific Car had a choice of the existing low pressure main or one nearby which would deliver 5 lb of pressure. However, the use of either main would make it necessary to replace the existing acetylene system with larger pipes in order to obtain a sufficient volume, a costly installation. The solution, Burr decided, would be to raise the pressure of the existing main to 50 lb, thereby providing the necessary volume of natural gas for even the largest of torches. This arrangement would also make it unnecessary to install any new pipelines, as the existing acetylene system would be completely satisfactory.

The result was the specifying of a vane-type booster pump (Allis-Chalmers, model 5CCB) which produces 4260 cu ft per hour at 50 lb of pressure with a 15 hp motor. The pump also has an after-cooling unit built into it, an automatic time and temperature control and automatic lubrication. An added advantage of the unit is that it can be installed easily and quickly in existing structures and doesn't require a special location or extreme safety precautions.

MONTHLY COST BREAKDOWN SHOWING THE SAVINGS REALIZED AFTER CHANGING FROM ACETYLENE TO NATURAL GAS

	Acetylene		Natural Gas	
	Amount	Cost	Amount	Cost
Fuel	25,400 cu ft	$ 488.81	39,522 cu ft	$ 178.00
Oxygen				
Pre-heat	43,180 cu ft	280.67	79,044 cu ft	434.74
Cutting	98,674 cu ft	641.38	98,674 cu ft	542.71*
Total monthly		$1410.86		$1155.45

Net monthly savings are $255.41, or $3065 annually for fuel.

Annual savings:

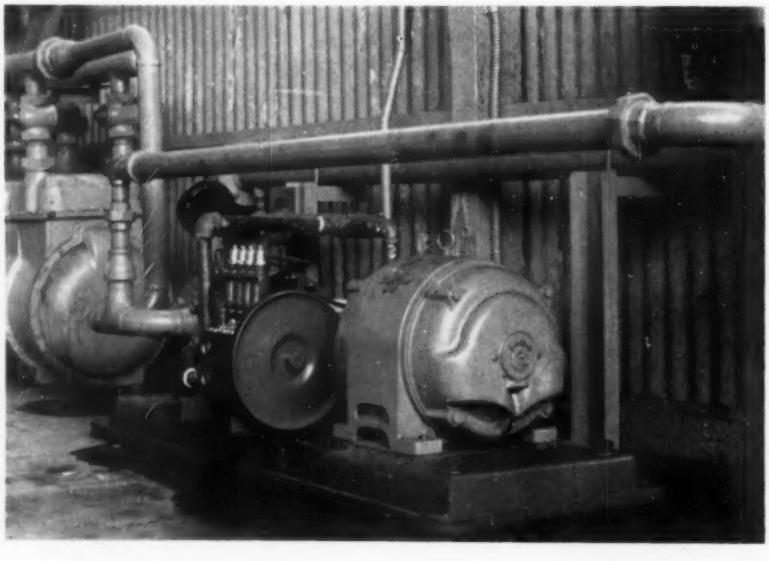
Fuel	$3065.00
Labor costs for charging generators and dumping sludge	2600.00
Charges for hauling sludge away	500.00
Total annually	$6165.00**

Additional Savings:

As only 39,522 cu ft of the monthly supply of 200 Mcf of natural gas is used for cutting and heating, a total of 160,478 cu ft is "free" gas, available for space heating during the winter.

*While the amount of oxygen used for cutting remains the same as with acetylene, the total price is reduced because the increased consumption of oxygen offers a more attractive unit price classification. It should be noted that while a transition from acetylene to natural gas results in a greater consumption of oxygen, the additional cost for this item is offset when all costs are computed.

**The total annual savings do not include a significant amount which will result from the reduction in plant insurance rates.



Booster pump installation delivers 4260 cu ft of natural gas per hour at 50 lb of pressure. This volume makes it possible to use the largest size heating torches, which was not possible with the plant's acetylene system.

On analyzing the existing acetylene transmission system for conversion to natural gas, the following changes were found to be necessary:

From pump to station valves—no changes.

From station valves to regulators — The Oxweld R-39 acetylene regulators had to be converted to R-39-H hydrogen regulators for the 50-lb pressure of the natural gas. The oxygen regulators required no alterations.

From regulators to hoses—Cutting torches with existing ¼-in. lines and 3/16-in. whips proved satisfactory in their existing state. However, the hoses to the heating torches were changed to 5/16 in. for most operations, in order to obtain a sufficient supply of oxygen to go along with the greater volume of natural gas needed for larger torches.

From hoses to torches—By using high pressure natural gas, the existing acetylene torches could be used without any alterations as acetylene is also a high pressure gas.

From torches to tips—All new tips were required at this phase of the transition, which was one of the most critical areas in the technological sense. Straight burning was found to equal acetylene, but this was not the case with 45-deg. bevelling. Using recommended tips at the outset, Pacific Car soon found that the cutting was extremely slow. The solution to this problem came with the adoption of Acetegen three-piece tips, which have an extra half row of pre-heat orifices which greatly facilitate cutting, making it comparable to acetylene in all respects.

Robert C. Hermon, plant superintendent of the Structural Steel division, said that the transition from acetylene to natural gas was done easily, adding that the new system was proving highly satisfactory. Hermon pointed out that by devoting about 100 man-hours to preparation work—readying the main, installing the booster pump and working on the pipelines—it was possible to make the transition without any down time. The final changeover was done on a weekend by a four-man crew who worked only one and one-half days on the project, he said.

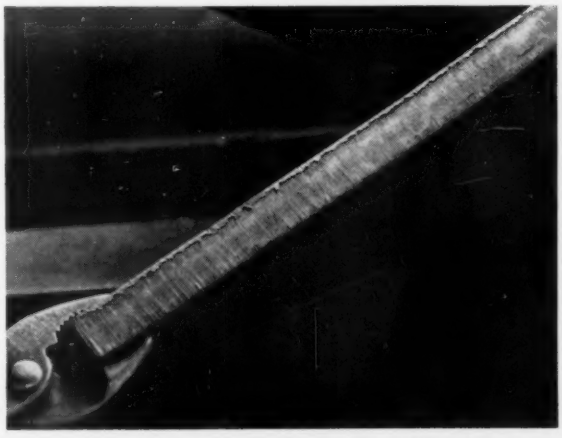
The major problem in changing to natural gas was training the shop personnel in the handling of the new flame, which requires more careful adjusting than acetylene. This was accomplished by having the crews work with propane for a week in advance, with the result that there was no drop in production at the time of the changeover.

Hermon pointed out that another advantage of using natural gas in structural steel fabricating plants today is the fuel's compatibility with many of the new types of metals which are being used in an increasingly larger volume. Embodying certain distinctive characteristics, many of these space-age metals require careful handling, including the type and amount of heat to which they can be subjected. Because natural gas has a small heat effect zone, it is especially suited for use on those exotic alloys which cannot be subjected to extremes in temperature, he said.

Another appeal of natural gas which Pacific Car discovered is that of a substantial downward adjustment in insurance rates because the fuel is more stable than acetylene. Also, labor costs for manufacturing acetylene and the charges for disposing of the messy calcium sludge were also obviated with the introduction of natural gas. Furthermore, the division found that by removing the generators, the former acetylene facility could be turned into valuable storage space.

Summarizing their experience with making the transition to natural gas, Hermon and Burr both agreed that this fuel is highly preferable to acetylene because of reduced costs and increased efficiency. Furthermore, it was stressed, the need for this fuel in structural steel plants should increase with the appearance of more specialized metals which are best handled with a natural gas flame.

Pacific Car's Renton and Kenworth Motor Truck divisions—both in the Seattle area—are also users of natural gas, obtaining their supply directly from high pressure mains. The company's other divisions are Peterbilt Motors Co., Newark, Calif.; KW-Dart Truck Co., Kansas City, Mo., and Canadian Kenworth, Ltd., Vancouver, B. C. ■



On rusty plates, natural gas used in Acetegen three-piece tip provides a much cleaner cut. Photo at left shows gouges that occur when acetylene flame fails to penetrate heavy scale. With natural gas, the extra half row of orifices in this special tip heat metal so that flame will cut smoothly and evenly without any flareups (right).

SAS *presents a preview of*

MARBON CHEMICAL'S New Plastics Pipe Movie

starring

ABS Pipe Made of Cycolac Brand Polymers

and featuring

The Original Script

"IN Phoenix, Ariz., men and machines ready the trenches for gas lines that will light the ranges and warm the homes of this desert oasis. This is Fairway Estates . . . just outside Phoenix, developed by one of the nation's largest home builders, John F. Long, Inc. And here, Arizona Public Service Co., one of the leaders in the use of ABS plastics pipe in the field of gas transmission, is installing a system that stands as a model for gas utilities everywhere.

"The reasons for the trend to ABS plastics in gas transmission are basically the same as in other fields except that in the gas industry safety—as well as long service life—is of major importance. The fact that the pipe will last indefinitely (and—in small diameters—can be used for relining existing metal pipe between the main and the meter without seriously disturbing the ground cover) have greatly contributed to its widespread popularity.

"Of course, the ease of handling, plus speed of assembly and installation, are the principal reasons for using ABS plastics pipe. For example, this main (Frame 1) *runs 485 ft. Yet, the entire length can be solvent welded, including wrapping the copper locator wire, in approximately five minutes.*

"The line is now ready for testing. Normal procedure is to air test the entire length of the main before placing the pipe in the ditch. A main of this type carries gas at 60 psi and this same pressure is maintained in the service line up to the meter installation. The testing device is a Dragnet Leak Detector, which is quite sensitive. It enables a workman to detect any leak in the pipe with accuracy—quickly and positively.

"ABS is tough! Notice how delicately the 485-ft main is tossed in the ditch! (Frame 2) *No lifting devices, no cranes are needed. One man and one hand is all that're necessary. Compare this with handling metal pipe.*

"Installing the plastic pipe under a street to connect to the steel main is also relatively simple. A hole is drilled with compressed air and water. The 1¼-in. ABS distribution main is pushed through the drilled hole. Other than protecting the end of the pipe to prevent dirt from getting into it, no special precautions are needed.

"A 'hot tapping' procedure (Frame 3) *is used to connect the ABS pipe to the 4-in. gas-filled steel main. And the ABS distribution main is connected to it with a Dresser coupling. A feeder valve is installed to complete the tap-in procedure. All this is done without interrupting gas service. The locator circuit is completed by welding the copper wire to the steel main.*

"Meanwhile, another crew is working on the ½-in. ABS house service lines, which are being solvent-welded and prepared for coupling to the house meter. The service lines are also pressure tested for leaks.

"Here (Frame 4) *is a dramatic example of the ease of handling ABS plastics pipe. It would take quite a man to accomplish this with four 70-ft lengths of metal pipe.*

"The small ditcher used for installing these service lines makes a trench approximately 5 in. wide and 24 to 30 in. deep. In a busy construction area this permits trucks and other equipment to pass over the

ditch. In this way, no inconvenience nor delays result from the ditching.

"The connection of the house service line to the 1¼-in. distribution main (Frame 5) *is again made with a 'hot tap,' using a Mueller valve tee, which has its own cutting ring and seal. First, the tee is solvent welded onto the ABS main, then strapped in place for extra safety. The locator wire is cut to length.*

"A conventional pipe cutter is used to shorten the service line, which is then permanently attached to the valve tee—again through simple solvent welding. The ease and simplicity of work.ng with plastics pipe is readily evident throughout this entire installation. A six-man crew plus two part-time helpers on the supply truck can install up to 35 average services of the type shown in one eight-hr shift. The cap of the Mueller tee is removed and a hole is drilled in the main with the integral cutting edge. The 'O' ring seal prevents the escape of gas.

"The job is completed when backfilled by hand. Larger trenches are backfilled mechanically and the earth tamped with a power tamper. If rocky soil is involved, a 6-in. pad of earth is placed over the ABS pipe before backfilling.

"What happens if a break accidentally occurs in an ABS line due to new excavation or ditching? Arizona Public Service has developed this simple repair procedure. Using a special tool, the gas flow is quickly stopped by pinching off the end of the ABS pipe—as shown in this demonstration (Frame 6). *The broken end is temporarily capped with a metal clamp. This permits the pinching tool to be removed. Glass tape is then applied behind the pinched off section to distribute the clamp stress. The taped area is now clamped. This permits removal of the cap that was placed over the broken area.*

"The broken section of pipe is simply removed by sawing and a new section of plastic is solvent-welded into place. Only localized interruption in service occurs and a major shut off isn't necessary. This saves numerous, costly service calls to relight pilot lights and minimizes customer annoyance. Also, with ABS, service breaks by highway and other utility crews are immediately apparent. Metal, on the other hand, which may withstand such an initial impact, might fail later due to corrosion . . . with no way to trace back the costs to the offender.

"With a new section securely in place, the clamp can be removed, the gas flow resumed, and the tape removed from the pinched area. Arizona Public Service engineers have devised still another technique to complete the repair. A split piece of ABS pipe (Frame 7) *is solvent-welded to the pinched area with a special tool which both welds and rounds out the pipe at the same time. The weld is reinforced with wire. As you have just seen, ABS plastics pipe, because of its ease of solvent welding, its ease of handling due to its light weight—and its over-all toughness—makes the entire repair procedure a comparatively simple matter.*

"The building of Fairway Estates is a dynamic example of how modern materials, like ABS pipe, modern methods of installation, and modern maintenance practices, are leading the way towards a better way of life for us all." ■

COMMENTS ON HOW GOOD ARE *good* FLUID FLOW MEASUREMENTS

By Howard S. Bean • Consultant on Fluid Metering
Kensington, Md.

I AM asked occasionally "How good can the flow of a fluid be measured with a differential head meter, such as an orifice meter? Another way of asking the question, and which I prefer, is: "What is the probable uncertainty (in per cent) of a flow measurement with such a meter?"

Before attempting to answer, or to suggest a possible basis for answering the question, let us remember that differential head meters are used under a wide range of conditions, and for different purposes. There is the laboratory, both large and small scale, where conditions are carefully controlled and the various quantities involved are measured with precision grade instruments. Then there is the main field station in a building to which special attention was given to have proper installation conditions, and a good grade of commercial recording instruments were used. Lastly, we find those places where there appears to have been no thought given to proper installation conditions nor to the quality of equipment and instruments. Obviously there will be considerable difference between the final uncertainties in the quantities as metered under such different conditions.

As a start towards an answer to our question, I have prepared *Table 1* listing the several measured quantities and factors that are or may be involved in a fluid flow determination, or in the calibration of a flow meter. To each of these items I have assigned my estimate of the probable range of uncertainty (or tolerance range) to be expected in the measurement or evaluation of each for the range of conditions listed above. These uncertainties I have designated Δd, Δh and so on. The intended meaning of these deltas (Δ's) is the difference to be expected between the observed or determined value of a quantity and the true value if such were known or could be determined exactly.

To illustrate: the average diameter of an orifice as determined by measurements on four diameters was found to be 4.0024 in. Now suppose the diameter of this orifice could be determined exactly by some super-precise method. There is the possibility the first value would differ from the exact value by 0.0001 to 0.0004 in.

Again: in a laboratory, water used in calibration tests is drawn from a pond. Due to the minerals dissolved in this water, its true specific weight (if a careful determination were made) could differ from the value obtained from a table (e.g. Table 11, Fluid Meters—1959) by 2 to maybe 10 parts in 60,000.

It will be noticed that for all recording charts the deltas are not only the same but are in terms of a length—inch. Why? First, there are so many different charts and chart scales for recording pressure gauges and thermometers it is impractical to try to list even a fraction of them. Secondly, it is the width of the record line on the chart together with the width of the graduation lines and spaces between these lines that are the determining factors of the uncertainty of a chart reading. The width of the lines drawn by recording gauge pens are reported to range from about 0.008 in. to about 0.02 in. Probably 0.015 in. would be a fair average. The graduation lines on the chart would be in the same range. The distance

between the graduation lines of a chart ranges from about 0.04 in. to possibly 0.125 in. Thus it seems probable the uncertainty in estimating (reading) the position of a steady, smooth pen line, with respect to a chart scale, will be at least 0.01 in., and possibly 0.02 in. or more.

To express the uncertainty as a percentage will involve the position of the line with respect to the pen rest or "zero" position which sometimes coincides with the zero line of the chart scale. Suppose the line drawn by the pen as the chart moves is 2 in. out on the pen arc from the pen zero position. Then the uncertainty in reading this pen record will be somewhere between ± 1 and ± 2 parts in 200, or between ± 0.5 per cent and ± 1.0 per cent. If the zero of the chart scale coincides with the zero position of the pen, as with a differential pressure recorder, then the per cent uncertainty in terms of the differential pressure reading will be the same as the linear. It may be noted that in this case, the equality between the per cent linear uncertainty and the per cent scale reading uncertainty is independent of the total differential pressure range represented by the chart scale.

The same will apply to a static pressure gauge provided the pen zero and scale zero coincide and also that only gauge pressure is involved. However, if *absolute* pressure is required from the chart record, as is usual in gas measurements, then the difference between absolute pressure and gauge pressure will have to be taken into account. This difference will tend to decrease the percentage slightly.

With temperature recorders the chart usually is graduated in the ordinary Fahrenheit (or Centigrade) scale, and the zero temperature scale line may not be on the chart. In this case, and if ordinary temperature only is required, the uncertainty in terms of the temperature scale will have to be determined from the temperature scale reading and the line value in terms of the chart scale. However, where absolute temperatures are required, as with gas volume computations, the difference between the zero of the absolute scale and the ordinary scale must be taken into account. It amounts to having a gauge with a suppressed zero. This can be explained best with an example.

Assume the chart scale of the temperature recorder covers the range from 20 to 120 deg. F, and that the length of the pen arc is 5 in. Hence each inch of pen arc corresponds to 20 deg, and 0.01 in. to 0.2 deg. At a distance of 2 in., the temperature reading on the chart will be 60 deg. F. The corresponding absolute temperature is 60 + 460 or 520 Rankine. Thus the uncertainty in the absolute temperature is between ± 2 and ± 4 parts in 5200, or between ± 0.04 per cent and ± 0.08 per cent.

One well recognized procedure to establish the probable uncertainty, or the "tolerance" as it is called by many, of a factor determined by a calibration, such as the coefficient of a flow nozzle, is to determine the standard deviation of the several individual values and double it. The standard deviation is determined as follows: determine the departure of each individual value from the *most probable value* (or the average value); square these departures, add these squares, divide the sum by the number of individual determinations minus one, and take the square root of this quotient.

TABLE 1. Estimated Uncertainties in the Measurement or Evaluation of Items Involved in Fluid Metering

Item or Factor		Uncertainty Range		
Throat diameter of orifice or flow nozzle:	d < 5″	Δd	= ± 0.0001″	to ± 0.002″
	d > 5″	Δd	= ± 0.0002″	to ± 0.005″
Pipe diameter; 1-in. pipe to 30-in. OD pipe		ΔD	= ± 0.001″	to ± 0.10″
Static pressure: dead weight gage, single reading		Δp	= ± 0.05 lb	to ± 1.0 lb
dead weight gage, average 10 readings		Δp	= ± 0.01 lb	to ± 0.2 lb
test gage, single reading		Δp	= ± 0.1 lb	to ± 2.0 lb
test gage, average 10 readings		Δp	= ± 0.02 lb	to ± 0.5 lb
indicating gage, single reading		Δp	= ± 0.5 lb	to ± 10. lb
indicating gage, average 10 readings		Δp	= ± 0.1 lb	to ± 2. lb
recording chart, regardless of chart scale		ΔL	= ± 0.01″	to ± 0.05″
Differential pressure: mercury or water manometer, single reading		Δh	= ± 0.001″	to ± 0.25″
mercury or water manometer, average 10 readings		Δh	= ± 0.0002″	to ± 0.05″
recording chart, regardless of chart scale		ΔL	= ± 0.01″	to ± 0.05″
Temperature: mercury-in-glass, thermocouple, resistance thermo.		ΔT	= ± 0.01 °F	to ± 5. °F
temperature recorder, regardless of chart scale		ΔL	= ± 0.01″	to ± 0.05″
Specific weight (or density): water T < 140 F		Δγ	= ± 1 in 60,000	to ± 1 in 6,000
water T > 140 F		Δγ	= ± 1 in 12,000	to ± 1 in 3,000
other liquids, direct determination		Δγ	= ± 1 in 50,000	to ± 1 in 200
air		Δγ	= ± 1 in 5,000	to ± 1 in 200
steam, superheated		Δγ	= ± 1 in 2,000	to ± 1 in 200
steam, wet		Δγ	= ± 1 in 400	to ± 1 in 50
other gases, direct determination		Δγ	= ± 1 in 2,000	to ± 1 in 50
Specific gravity liquids		ΔG	= ± 1 in 5,000	to ± 1 in 50
gases		ΔG	= ± 1 in 2,000	to ± 1 in 50
Weighings, commercial scales		ΔW	= ± 1 in 10,000	to ± 1 in 100
Coefficient of discharge or of flow: by calibration		ΔC, ΔK	= ± 0.05%	to ± 1.0%
from table or curve		ΔC, ΔK	= ± 0.5%	to ± 5.0%
Compressibility or supercompressibility of gases		Δs, ΔZ	= ± 0.1%	to ± 5.0%
Expansion factor, compressible fluids $[x = \frac{p_1 - p_2}{p_1} 100]$		ΔY	= ± 0.5% of x	to ± 2% of x

Another method, and one which I think is entirely satisfactory for flow measurement work, is to take as the probable range of uncertainty the simple arithmetic average of the departures, of the several test values from the average value or from the curve best representing the test values. This was the procedure used in evaluating the agreement between the final correlation and the original test data which are the basis of the orifice coefficients given in the ASME Fluid Meter Report and the AGA Gas Measurement Report No. 3.[1, 2, 3]

Now a look at building up the uncertainty of a system. A basic concept for doing this is the improbability that the uncertainties of the individual items will all affect the final result in the same direction. This gives rise to taking the square root of the sum of the squares of the individual items. In doing this it is to be remembered that any item that enters the system as a square has double effect, but if it enters as the square root, the effect is one-half.

As an example, let us evaluate the uncertainty in a single calibration test of an orifice. The test data are: orifice diameter 1.9986 in.; differential pressure, average of 5 readings of a U-tube manometer 71.84 in. water at 85 deg. F; temperature of flowing water 75 deg. F (thermometer graduations 2 deg. F); net weight of water into weigh tank 2272.5 lb, minimum scale indication 1 lb; time interval 145.2 sec. by a stop-watch reading to 0.2 sec. The flow relationship may be represented by weight/time $= 0.0997\ K\ d^2 \sqrt{\gamma\ h}$, and *Table 2*, which shows evaluations of the uncertainties of the observed quantities, when combined give the possible uncertainty in the test objective, the flow coefficient K. Thus the estimated uncertainty in this single determination of the flow coefficient is ± 0.14 per cent.

From a quick study of this table we see immediately that if we wish to improve on our test procedure the place to start would be on the time. So suppose we replace the stop watch with a trigger-operated chronograph with which the time interval can be read to 0.05 sec. However, with a chronograph there will be a reading for the start as well as at the end. This will have the effect of giving us two time items each with an effect factor of one, and in *Table 2* the time item will be

TIME, start ± 0.05 sec. ± .034 per cent 1 .00118
TIME, end ± 0.05 sec. ± .034 per cent 1 .00118

Thus the overall uncertainty will be ± 0.065 per cent.

On the other hand suppose that instead of using a manometer the differential pressure is measured with a recording differential pressure gauge, 100-in. range (laid out on a 4-in. scale length). If we assume the position of the record line can be estimated to within ± 0.015 in., this would represent an uncertainty in the differential of ± 0.5 per cent. The resulting uncertainty in the coefficient would be ± 0.29 per cent or ± 0.26 per cent, depending on whether we used the stop watch or the chronograph. In this case the advantage of the chronometer over the stop watch has been wiped out.

Pursuing this a little further, suppose we proceed with the laboratory calibration of our orifice and make 10 or more tests, all the results coming within a band only 0.15 per cent wide. In other words, a single line or curve can represent the results within ± 0.075 per cent. Now the orifice plate, or even plate and tube, are taken to the place of use and installed in a pipeline. What positive assurance is there that in the new environment the uncertainty in the coefficient of this orifice is still only ± 0.08 per cent, or that the overall uncertainty in the measurement of fluid flow is not over ± 0.3 per cent? For my own part I would prefer to assume the uncertainty in the coefficient is now at least ± 0.1 per cent and possibly as much as ± 0.25 per cent, and that the uncertainty in our measurement of flow may be all of ± 0.5 per cent.

TABLE 2

Item	Estimated Uncertainty	Per Cent Uncertainty	Effect Factor	Square
Weight	±0.6 lb.	±0.026	1	0.00068
Time	±0.2 sec.	± .138	1	.0190
d^2	±0.0002″	± .01	2	.0004
γ	±3/20,000	± .015	½	.000056
h	±0.04″	± .056	½	.000784
K		±0.142		.02092

Now back to our original question. From our example we found that a simple change of only one element could halve or quadruple the magnitude of the combined uncertainty. To state it more generally: the uncertainty in the measurement of any fluid flow will depend upon *all* of the elements or factors by which the flow is determined. No general statement seems possible. To try to give a general statement could be very misleading. Each situation will be more or less independent. To be sure, in any one group or system there will be similar elements and to that extent some generalizations may be possible for that system.

The uncertainties which have been considered are those which arise from the seemingly unavoidable imperfections in instruments, tools, mechanisms and techniques. In using the uncertainties from *Table 1*, be realistic. It is very easy to be over confident and think we are better than we really are.[4, 5, 6]

A closing word about *Table 1*: the left column of plus or minus values are estimates of what should be attainable in good laboratories, by good operators with good equipment. The right column could be field conditions, and some "field" meter hook-ups even in a mid-city plant, are a long long way from what such should be. ■

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By Irving Deutsch, P. E.

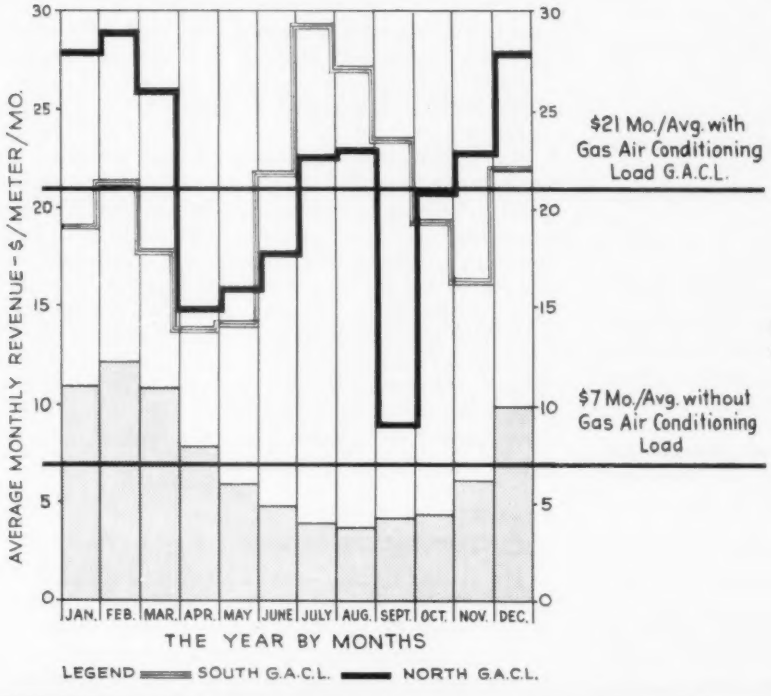


Fig. 1. Revenue per meter with and without gas air conditioning load.

PART 6: Gas utilization— Refrigeration and air conditioning

IN October, attention was focused on the atmospheric burner because it represents the major gas load, whether the application is industrial, residential, or commercial. Though other types of burners were not mentioned (such as the porous surface and catalytic surface burners), the basic combustion equations apply to limits of flammability, chemical combinations, efficiency, and heat of vaporization of water produced and specific heat of the flue product. Even in the refrigeration and air conditioning application, a burner is often used, or maybe more accurately "usually used," except when the gas is used as an engine fuel.

This month and next, we will stress the importance of refrigeration and air conditioning loads to the yearly economic operation of a gas system. Important elements of the absorption cycles, compression cycles, and heat pump will be presented. And an occasional dipping of the toe into the thermodynamics of the cycles will be resorted to for clarification and deeper understanding for those who wish it. But most important, the mystery of the "ton" and the "horsepower" will be solved in terms of "Btu."

HISTORY

Ferdinand Carre was nearly a century ahead of his time when, in the mid-19th century, he invented the modern absorption cycle to be operated by either gas or electricity. Development was not pushed because of many problems that beset the world and the United States in that period. In 1919, John Zander issued a booklet called "Modern Refrigeration" that revived interest in the absorption cycle. Several important automatic features were added by the Zander Refrigerating Co.

Application of gas to the compression cycle was made in the latter part of the 19th century when the internal combustion engine was used to power a compression-type refrigerator using gas as a fuel. Possibly the single most important component holding back progress in this field was the lack of low-cost, reliable temperature controls. Mass production of automobiles in the early 20th century made available the production of control devices needed in the refrigeration industry.

ECONOMIC IMPORTANCE

A gas refrigerator will supply a year-round load with a bit of an increase in summer months when it is needed most. The importance of this load has been recognized by manufacturers that now have newly designed models, available to the public and industry, styled and priced to compete with the best electric models available. More efficient, compact systems are the key to the new models. They, in turn, are the key to the "all-gas" kitchen; which, in turn, is the key to the all-gas home; which, in turn, sells the builder of homes on the idea of installing gas appliances. Simplicity of the absorption cycle provides trouble-free operation that permits a 10-year warranty to continue the tradition of reliable, long-lived, low-cost, trouble-free gas appliances.

Though the refrigerator supplies the ever welcome constant load, the air conditioner is the more dynamic load builder for the summer valley. To a greater or lesser extent, gas is being used in the summer valley for air conditioning indirectly where gas is used by combination utilities for boiler fuel to generate electricity to meet the growing electric air conditioning load. It is sold at low rates by gas utilities to electric companies for boiler fuel in order to permit the purchase of economical firm contract gas by gas companies in quantities that will permit the gas company to meet winter peak loads without excessive peak shaving. The fact that manufacturers have not developed the gas refrigerator and air conditioner as aggressively as their electric cousins, despite many advantages, has held back the direct use of gas for the summer load and has thereby not only deprived gas companies of revenue from such sales of gas, but has further lost load because sales are lost also on year-round air conditioning and all-gas home construction. This vicious cycle doesn't really stop here because when gas revenue is cut, incentive to develop new production equipment for future peak shaving loads and firm loads is reduced, and money to provide better service—a constant goal—is not available; hence, again sales are hurt.

Fig. 1 shows the importance of the year-round air conditioning load for both a southern and northern utility. The average revenue figure will vary widely depending on rates and other local conditions. It is generally accepted that combination companies feel the loss of the gas air conditioning load to a lesser extent than the all-gas company. But this must be evaluated from the standpoint of the loss of sales of winter heating and year-round air conditioning for the entire house, plus the loss of refrigeration load, and water heater load. This, of course, is a job for the combination company to evaluate on the basis of deriving maximum return on investment for the stockholder.

TRANSFER OF ENERGY AND TEMPERATURE CHANGE

The above title may sound a bit stiff, but it sums up what refrigeration and air conditioning are all about. What's more, the study of this transfer of energy in a large, many-atomed and many-moleculed system (macroscopic) is thermodynamics. For the purposes of this section, only the important conclusions developed from thermodynamics will be used to explain the nature of various refrigeration and air conditioning cycles.

The coefficient of performance of a machine is defined as the desired effect divided by the energy supplied to produce the effect. Analysis of an ideal thermodynamic heat cycle (called the Carnot cycle—not practical and almost impossible), provides an extremely simple relation for the COP (coefficient of performance), involving only the temperatures of the energy supply, T_1, and the temperature of the discarded energy, T_2, as follows:

$$\text{COP} = \frac{\text{heat supplied-heat rejected}}{\text{heat supplied}} = \frac{T_1 - T_2}{T_1}$$

Where temperatures, T, = deg. F + 460 = deg. absolute

Some examples will help to bring out some basic perature difference increases.

Example No. 1:

Heat engine: work output desired from heat input:

T_1 = 200 deg. F + 460 = 660 deg. abs.

T_2 = 100 deg. F + 460 = 560 deg. abs.

$$\text{COP} = \frac{660 - 560}{660} = .152$$

For a heat engine, the COP increases as the temperature difference increases.

Example No. 2:

Refrigerating machine: heat removal desired from work supplied:

Heat withdrawn from room at temperature,

$$T_2 = 560 \text{ deg. A}$$

Heat discarded to room at temperature,

$$T_1 = 660 \text{ deg. A}$$

$$\text{COP} = \frac{\text{heat removed}}{\text{work supplied}} = \frac{560}{660 - 560} = 5.6$$

The COP for the refrigerating machine is 370 times greater than for the heat engine under the same temperature conditions because the heat engine transforms heat to work, but the refrigerating machine merely raises the level of heat energy from T_2 to T_1.

Example No. 3:

Heat pump: Heat supply desired from work supplied:

Heat discarded at $T_1 = 660$ deg. A

Heat withdrawn from $T_2 = 560$ deg. A

$$\text{COP} = \frac{\text{heat discarded}}{\text{work supplied}} = \frac{660}{660 - 560} = 6.6$$

This increase in COP of the heat pump as compared to the refrigeration machine may be accounted for, in rough analogy, by the thought that it is easier to push heat from cold to hot because the heat rejection of the work supply helps to push toward the hot rather than cold. This will become clearer when the actual cycles are considered.

COMPRESSION CYCLE

From Examples 2 and 3, it is not really proper to call a refrigerator only a cooling machine because it is also a heating machine. Or, if you wish, a refrigerator can be a heating machine when it is not a cooling machine. Or, it can be both if both heat and cold are desired. A schematic of a compression type heat transfer system is shown in *Fig. 2*. The system depends upon a refrigerant that can be easily condensed from a gas to a liquid by the compressor, with a rise in temperature of the refrigerant, and subsequent cooling by circulating the refrigerant through a long cooling coil over which either cooling air or water is passed. An expansion valve permits controlled evaporation of the liquid in the evaporator with a corresponding drop in temperature because evaporation is a cooling process (recall rubbing alcohol on your hand or back). Warm air to be cooled gives heat to the refrigerant and is cooled while the heated refrigerant is drawn into the compressor on the suction stroke. As mentioned, the compressor may be driven by any type of engine or motor; hence, if gas is the fuel, and automatic controls can be provided to start the engine when compression is needed, an automatic gas refrigerator or air conditioner can be designed. This type of system is one of the three major classes of gas air conditioning systems, and can be used for large size commercial and industrial refrigeration, as well as residential.

Next month, we will continue this discussion, covering absorption systems, direct-fired household refrigerators; absorption system, direct and indirect air conditioning; comparison of COP; and refrigerator sizes. ■

(For a copy of the addendum to this section, write to the Editor, GAS Magazine, 198 S. Alvarado St., Los Angeles 57.)

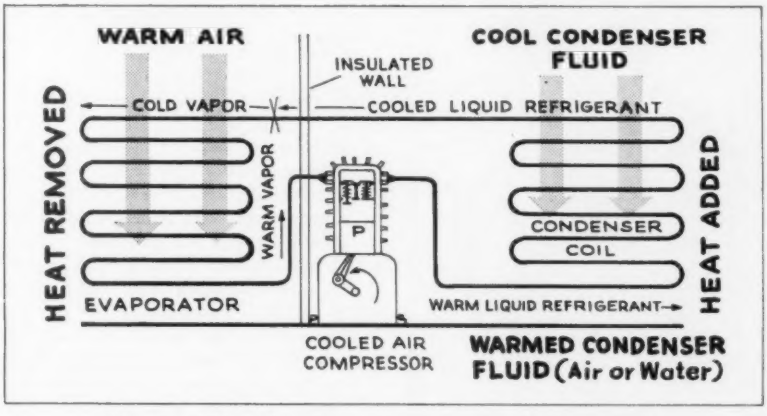


Fig. 2. Schematic of compressor cycle. Heat removed from left by evaporator is pumped to the right by the compressor to the condenser where heat is added to right.

How to determine internal condition of gas meters:

Record differential pressure

EVALUATION and development tests of domestic meters at Southern California Gas Co. require that the internal condition of a meter be examined while the meter is in operation. A number of faulty conditions that may exist in a meter can be determined by measuring differential pressure with a strain gauge transducer and recording the differential pressure on a Brush Instruments direct writing recorder.

For each type and size of meter tested, several differential pressure pulsation traces may be recorded. Certain defects in the internal workings of the meter will cause a characteristic variation from this trace. During development or checkout, a study of the traces will reveal where a fault may lie or what changes must be made to improve its operation.

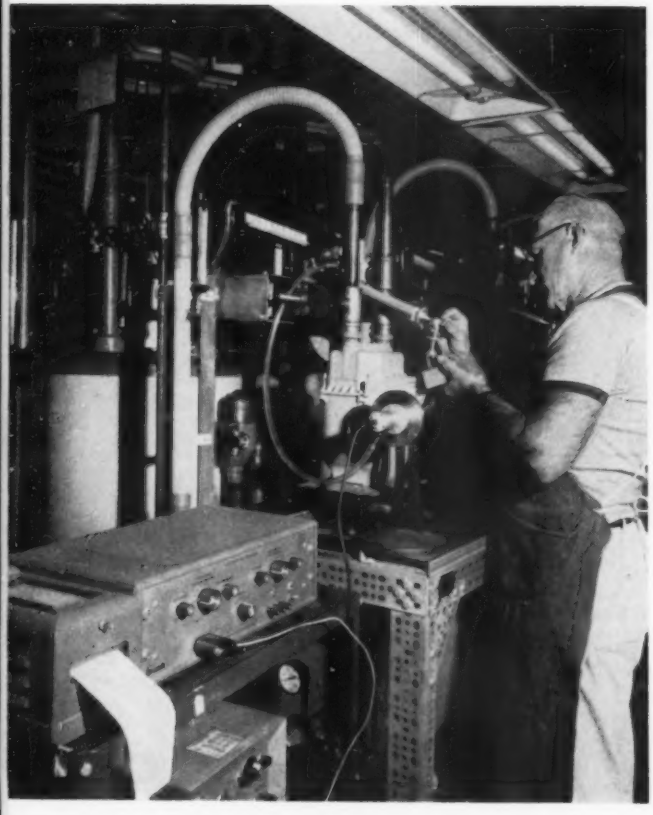
TEST SETUP

Included in the testing of all meters is a proof test using a bell prover. The prover contains a known volume of air which is kept at a constant pressure by known counterweights. It is important that this pressure remain constant; therefore, one of the periodic checks made on all provers is to record meter inlet pressure throughout an entire proof run in order to check for any bind or wear in the prover mechanism.

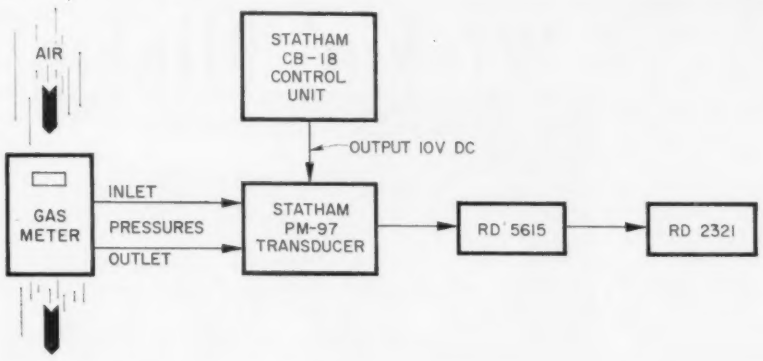
In conducting a proof run on a meter, the prover bell is filled and zeroed. A known quantity of air (usually 2 cu ft) is then run out of the bell through the meter. Rather than doing this manually, an automatic test has been set up by SoCal.

AUTOMATIC CONTROL

A photoelectric eye is focused on the test hand of the meter. The hand completes one revolution each time 2 cu ft of air is passed through the meter. As the test hand starts to rotate, it actuates the photoelectric eye, and when it completes one revolution, it deactivates the eye. The photoelectric eye is part of an Adaptrol control unit that programs a series of events that make up one proving run. When the control unit is actuated, it automatically fills and zeroes



Equipment used for automatic meter proving, including a bell prover, differential slope gauge, meter in place for proof check, electronic eye for automatic control unit and Adaptrol automatic control unit. Plastic lines from inlet and outlet differential tap fittings to the slope-type differential gauge have been disconnected and replaced by plastic tubes from these fittings to a Statham transducer shown mounted on the stand in front of the meter. Brush recorder and amplifier are in left foreground, sitting on the stand above the transducer calibration unit. Prover operator is focusing electric eye of the automatic control unit on test hand of the meter, first step in proving the meter. Differential trace or recording is taken while meter is being proved.



Block diagram of differential pressure measurement during automatic testing of gas meters. Air is passed through meter. Inlet and outlet pressures are fed to the pressure transducer, amplified and recorded. Control unit shown calibrates the transducer.

the prover. It then makes an open flow run, shuts off the prover, refills it, zeroes it, makes a check run on the meter, and finally shuts off the prover.

A differential slope gauge that is part of the meter is normally used to read maximum and minimum pressures from which the differential pressure can be determined. During the automatic test, the two pressure connections on the slope gauge are disconnected and tied into a pressure transducer that converts the pressure fluctuations to electrical signals.

The output of the transducer is amplified and fed to a Brush direct writing recorder. The recorder is turned on automatically during the test run of the meter and turned off when the test is completed. Recordings of the differential pressures reveal not only the pressure, but also the characteristics of the meter which indicate whether the meter is operating properly.

FAULTS THAT MAY BE DETECTED

Recorded differential pressures may indicate any of the following faults or necessary design changes:

1. Wear in the diaphragm side bracket causing the lower main movement to drop and rub the linkage on the adjustment button.

2. A shallow diaphragm causing a restriction of the meter's outstroke or instroke.

3. Poor adjustment of the flag arm division, causing a restriction of the diaphragm stroke.

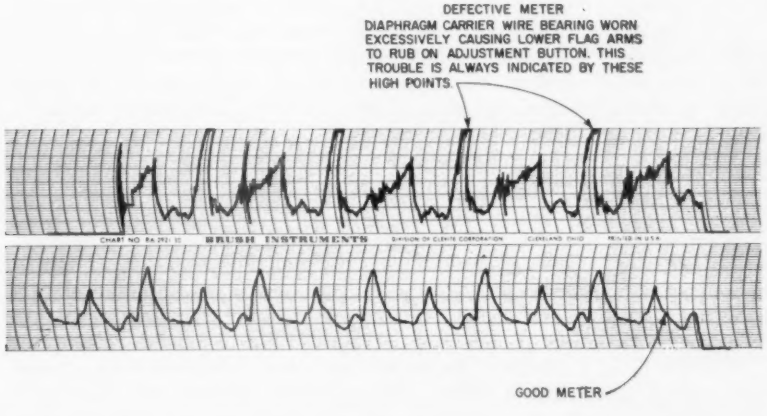
4. Diaphragm carrier bracket not being centered in the diaphragm disc, causing the diaphragm to tip to one side.

5. Gummy valves and seats causing a resistance to rotation of the meter components.

6. Tight packing in the flag rod stuffing box causing a restriction of the cycling of the meter components.

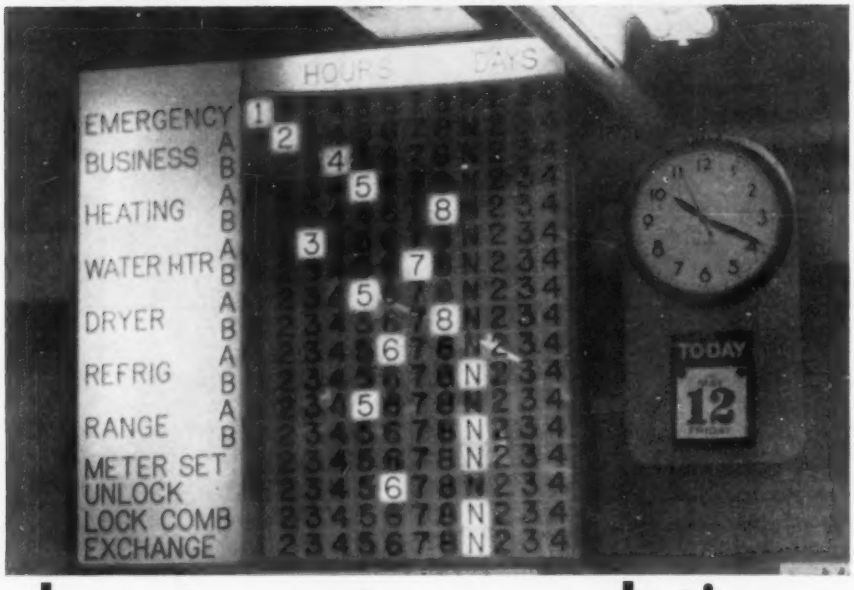
In addition to measurement of differential pressure, the Brush recorder, when used with an appropriate transducer, can be connected to record pulses of rotary meters to count revolutions. A rotary meter has four distinct pulses per revolution. Accurate measurement of pulses permits determination of speed or flow rate, which can in turn be totalized to determine accuracy or proof.

During checks of faulty meters, it is hoped that the chart paper from the recorder showing the differential trace may be attached to the meter and that it can be used by the workmen to assist in locating troubles. ■


DEFECTIVE METER
DIAPHRAGM CARRIER WIRE BEARING WORN EXCESSIVELY CAUSING LOWER FLAG ARMS TO RUB ON ADJUSTMENT BUTTON. THIS TROUBLE IS ALWAYS INDICATED BY THESE HIGH POINTS.
BRUSH INSTRUMENTS
GOOD METER

UPPER: Differential trace of good meter, showing maximum and minimum pressure. LOWER: Differential trace of defective meter. Trace reveals that diaphragm carrier wire bearings are worn excessively causing the lower flag arms to rub on the adjustment button. This defect is always indicated by the high peaks recorded. (Calibration is .40 in. w.c. full scale or one division equals .01 in. w.c.; chart speed, 5 MM/sec.)

Winkin' Blinkin' Board



boosts customer relations

By Herb Dunlop • Supervisor, Customers' Service
Consumers' Gas Co., Toronto, Canada

THE improvement of our service to customers is a perpetual objective at The Consumers' Gas Co. in Toronto. Service has always been important to us, and yet some time ago we found that our service did not meet the standards our customers expected or deserved.

Our customers' service personnel in taking a customer's request for service were unable to give the customer a satisfactory answer as to when the serviceman would call. The promise that our man would call "as soon as possible" met with increasing customer resistance, for so much depended on how this was interpreted. It could mean our man would be there almost immediately, or it might mean that several hours would pass before a serviceman was able to make the call.

To overcome this service deficiency, our service department developed a system whereby it would evaluate its work load and supply definite information to our telephone service section as to "target times" for all classes of work. By "target times," we meant the total elapsed time between the customer placing a call and the arrival of the serviceman. This information could then be used when taking a call from any customer who wished to know, at least approximately, how soon our serviceman could be expected. The target times were to be added to all orders except those where a customer called in a few days in advance and requested a specific date which was beyond the scheduled work period.

On all new printings of our work orders we have provided a box, designated as "Priority," which the telephone service operators use to show the target time which was in force when the order was taken. The operators also add the time the order was taken on any same-day calls. The orders are put through an incoming time stamp at the dispatch office, and it is their responsibility to ensure that the orders are dispatched in time for the targets to be met.

The evaluation of the work load and the setting of the target times is a service department responsibility, and control of the operation must remain with their dispatch office. Some experiments were carried out in order to determine the best way to provide target time information. Our objective was to have a board of some sort which would provide highly visible informa-

Fig. 1 (above). The illuminated information board as seen by the telephone service section.

tion in the telephone service section to guide the operators in their contacts with customers, and which could be changed easily by dispatch personnel as the work load warranted.

The use of an electric panel in the telephone service section, with control switches in the dispatch office, was the logical solution and we started to plan such a device.

We wanted the panel to be as compact as possible. Our problem was to make the information brief and concise, so that a telephone service operator could tell at a glance the target time for any type of call. We finally decided to break our work down into the major categories and proceed from there.

First we listed emergency, which in our operation includes all escapes of gas, or other complaints of a serious nature. Next was business, which meant a commercial or industrial customer, no matter what the appliance. These were followed by central heating, automatic water heaters, dryers, refrigerators, and ranges. All these categories, except emergency, were subdivided into an "A" or "B" class, which for our purposes meant "Urgent" or "Non-Urgent" types of calls. Then we listed the various types of orders that we use when a meter is the main reason for the visit to the customer's premises: meter set, unlock, lock, or combination lock and unlock, exchanges, and removals. We found that this gave us an adequate list to cover all routine operations and that we could incorporate it all on a panel 48-in. x 48-in. (See *Fig. 1.*)

We were ready to go ahead and put our plan into operation. But, as we had never heard of a device which met our specifications, it seemed that if we wanted one we would have to build it.

We took our ideas to the tradesmen in the carpenters' shop and provided them with rough sketches of what we thought the board should be like. They were certain they could build it, and went about the task with enthusiasm.

Two units were constructed: The illuminated information board for the telephone service section and the control panel in the service department dispatch office.

The information board was designed to be mounted on top of our end row of Kardex files where it would be seen easily from any part of the telephone service section. The overall dimensions of the main body of the board are 48 in. x 48 in. x 8 in., which includes the hinged face. The base is 50 in. x 11 in. x 1 in.

The face of the board is a sheet of heavy and rigid white plastic mounted in a frame. The frame is attached to the main body of the board by a full length piano hinge down the right side. This allows the face to be swung open to service the lamps when necessary (*Fig. 2*). Two fasteners on the left side secure the face when it is closed. We used 2-in. raised black plastic stick-on numbers and letters for printing the necessary information on the face of the board. This makes the detail stand out when the lamps are turned on.

The basic framework of the board is ¾-in. plywood and it provides room for three compartments. One section is equipped with two 3-ft fluorescent lamps to illuminate the categories of work. It occupies the left hand side of the board and is 15¾ in. x 46½ in. x 3¾ in. It is ventilated by a perforated panel insert low at the back and a row of holes along the top. Another section illuminates the designation strip "Hours—Days." It has one 2-ft fluorescent lamp and is 30 in. x 3 in. x 3¾ in. It is ventilated by a row of holes along the top. The remainder of the space is required to accommodate the unit which contains the individual cubicles for 204 low voltage lamps.

The construction of the unit of 204 cubicles was actually undertaken first. We required 17 rows of 12 lamps each to cover the target times. These were to light up, as required, the figures 1,2,3,4,5,6,7 and 8 under Hours, and N,2,3,4 under Days. The hours are self-explanatory but N means Next Working Day, 2 under Days means the Second Working Day, etc. Our carpenters made this unit like an egg crate by using ¼-in. plywood and it contains 17 rows of 12-2¼-in x 2¼-in. x 3-in. deep cubicles. The finished unit is 30 in. wide and 42½ in. high and was given a coat of aluminum paint. The front of the unit was left open so that when a lamp was on a square of light would shine behind the required figure.

The back of the unit is a sheet of peg board. Peg board was chosen for two reasons. The holes would allow the heat from the lamps to disperse through the back and our men found they could save a lot of time in attaching and wiring the lamp sockets. We used china sockets that had front wiring connections and we wanted to make our connections outside of the cubicles. To accomplish this, they put a 1-in. brass bolt through each of the two holes which were intended for fastening the socket, and soldered two short lengths of wire which joined one of the electrical connections to each of the bolts.

The wire used was heavy enough to keep the bolts in place. These bolts slipped through the peg board and centered the socket in each cubicle. When the nuts were tightened we had the sockets securely fastened and also a convenient way to make our low voltage electrical connections.

The compartments for the fluorescent lamps were lined with asbestos paper and BX cable was used to make all line voltage connections. These lamps are controlled by a single switch mounted in a junction box which is centered in the section containing the two 3-ft fluorescent lamps. The switch is operated from the back of the board.

The 12-v current required to operate the individual lamps in the cubicles is obtained from a transformer mounted on the wall directly behind the board. This current flows to the control panel in the dispatch office where the settings of their switches determine which lamp is on for each work category.

The control panel is a compact unit which has seventeen 12-position rotary switches (*Fig.* 3). A face plate under each switch is marked from 1 to 12. The figures 1 to 8 are for hours, 9 is N or next day, 10—2 days, 11—3 days, 12—4 days. There is one switch for each row of lamps in each work category, and at the upper left hand corner is a pilot lamp which glows red to indicate that the current is on. The panel itself was constructed of ½-in. plywood and has a sloping front. Heavy grey linoleum was used to cover the wooden frame and give it a very finished look. The printing was done in waterproof ink and the whole

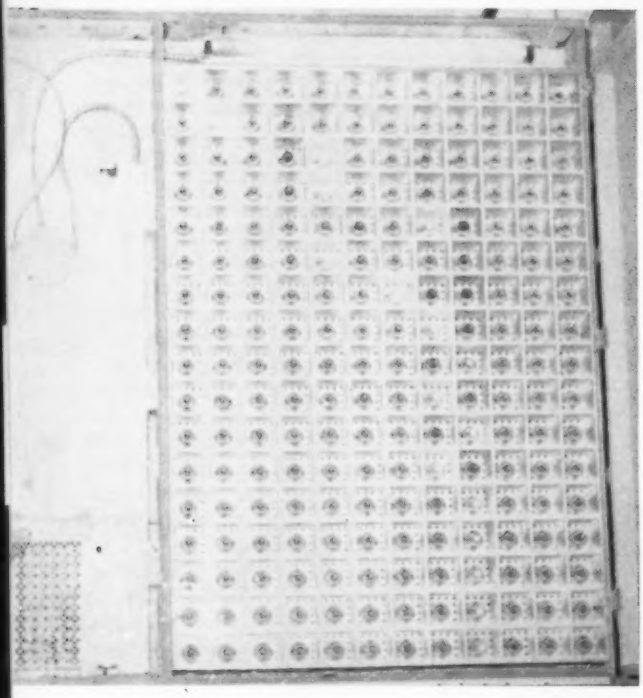


Fig. 2. Service target board with face swung out to show interior detail.

panel given several coats of clear varnish.

All the wiring was done by our own craftsmen, and the low voltage circuits between the control panel and the illuminated board were wired as follows. A single hot lead was taken to the center of each 12-position switch. The 12 positions around each switch were connected to wires which would lead back to an individual work category.

To accomplish this it was necessary to use four 52-pair cables, and one 14-pair cable. Wiring of the illuminated board was done by using a common ground on all low voltage lamps which simplified the job to a considerable extent. The color coding of the wires in the cables was used in making the final connections from the control panel switches to the corresponding lamps on the board.

The finished job looked exceptionally good to us and it worked perfectly. Along the way we had generated a lot of enthusiasm for the project, and we found that it even had a nickname. "The Winkin' Blinkin' Board," from the way the light ran along the rows as the target times were changed. We were well satisfied with the job and were very proud when it passed the final test. It has been approved and wears its label to show that the Ontario Hydro Electric Power Commission have inspected and approved it as a Special Device.

In order to make it easy for our telephone service operators to use the board, we added brackets and a panel at the right hand side which was equipped with a clock and a calendar. At a single glance they can get all the information required. They can time their order, advise the customer how soon they can expect our man, and check the date.

The lights in the telephone service section, the service target board and the clock are all connected to our auxiliary power system. In the event of a power failure we switch over immediately to power supplied by our natural gas generator.

We feel that the service target board has done a good job for us in correcting a customer relations problem. It has also produced additional benefits, for when our telephone service operators advise a customer that a man will arrive within a specified time, the customer is not so apt to leave the premises before that time has elapsed. This has resulted in a reduction in the number of "outs" on our same-day calls.

Winkin' Blinkin' has certainly proved itself to be well worth the effort spent on its creation. ■

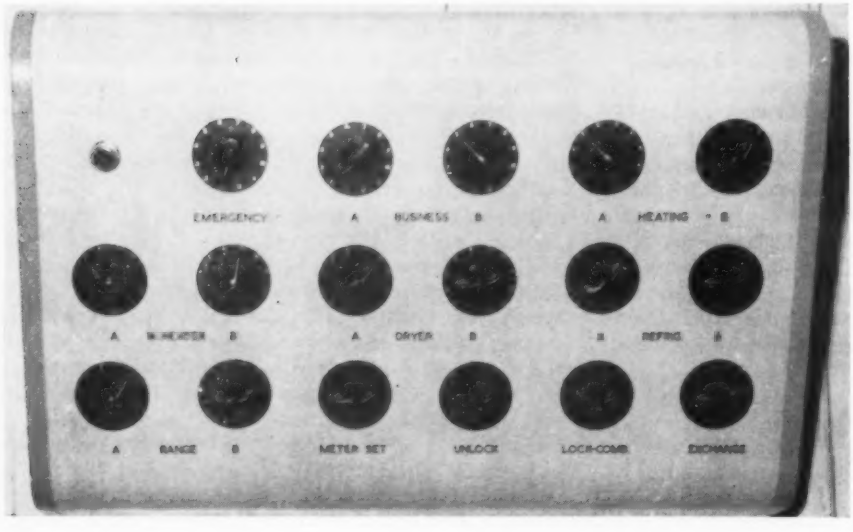


Fig. 3. The control panel mounted on the wall behind the dispatch desk.

GAS DISTRIBUTION NEWS

Old Comstock mine tunnel may house gas

A tunnel which once drained water from the famous Comstock mines of Nevada may be restored and used as an underground reservoir for natural gas.

Sierra Pacific Power Co. has begun clearing Sutro tunnel mouth so water can drain out and permit geologists to enter and study the feasibility of the plan.

A company spokesman said the tunnel could be an important factor in piping natural gas to the Reno area from the south.

The tunnel was begun in 1869. It extends from its entrance near Dayton, Nev., to mine shafts 1800 ft beneath the surface at famed Virginia City. It is about four miles long.

Good venting practices promoted

William Wallace Co.'s Metalbestos division is in the midst of a vigorous program to promote good venting practices throughout the gas industry.

Focal point of the Belmont, Calif. company's program is its scientific guide to gas venting, "The Metalbestos Gas Vent Tables and Handbook."

Alan Kinkead, president of the company, feels the guide is in itself a code of good practices. It contains the latest data on the use of Metalbestos gas vents up to 4 in. in diameter for venting gas appliances up to 10-million Btu capacity. The results are based on 15 years of research and testing in the field and laboratory.

The handbook is primarily the work of Richard L. Stone, chief research engineer for the company. Before joining William Wallace, Stone was senior research engineer at the AGA Laboratories. Assisting him were Frank Fields, application engineer, and George Cunnington.

Controls Co. expands

Controls Co. of America has acquired Thermac Co., Corona, Calif.

The new Thermac Gas division will take over the manufacture and sale of gas controls and automatic gas ignition systems heretofore manufactured by the Heating & Air Conditioning division in Milwaukee.

E. W. McKinley, president of Thermac, becomes a vice president of Controls Co. and general manager of the new division. I. E. McKinley, chairman and founder of Thermac, becomes a director of Controls Co.

NFPA issues 1961-62 fire codes

A new and revised 7-volume edition of the National Fire Codes has been published by the National Fire Protection Association.

These 1961-1962 codes incorporate 48 fire protection standards adopted by the association this year, plus 138 other current NFPA standards.

The seven major categories cover flammable liquids and gases; combustible solids, dusts, chemicals and explosives; building construction and equipment; fixed extinguishing equipment; electric; transportation; and mobile fire equipment, organization and management.

Additional information on the codes (which sell for $7 per volume, $40 for the set of seven) is available from NFPA, 60 Batterymarch St., Boston 10.

Lease program is success

Citizens Gas & Coke Utility, Indianapolis, has completed its sixth year with the Ruud commercial gas water heater leasing program.

In that time, 874 units were installed. Total new sendout contributed by the program is estimated at over 790 MMcf of 800-Btu mixed gas. In the year prior to the leasing program, Citizens Gas sold 27 commercial water heaters, compared to the average of 145 a year since.

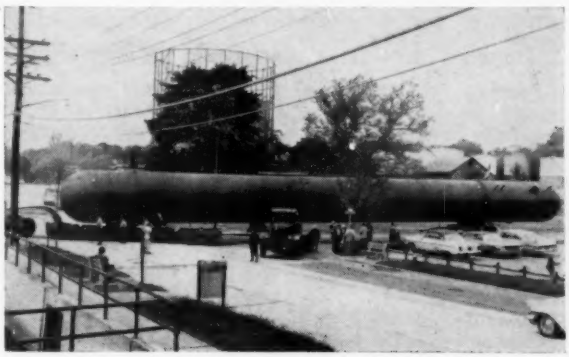
News continued on page 90

LILCO solves storage problem

Six 90,000-gal. Hackney storage tanks were delivered recently to Long Island Lighting Co.'s Glenwood gas plant by Pressed Steel Tank Co.

The tanks measure 11 ft in diameter, 134 ft in overall length, and weigh about 90 tons each. They will double the present storage capacity of the Glenwood plant. Capital investment required for six large tanks was less than the estimate for 18 storage tanks of the normal 30,000-gal. capacity.

The photo shows the most difficult turn along the way, as one of the tanks is trucked from rail siding to permanent location at Glenwood Landing.



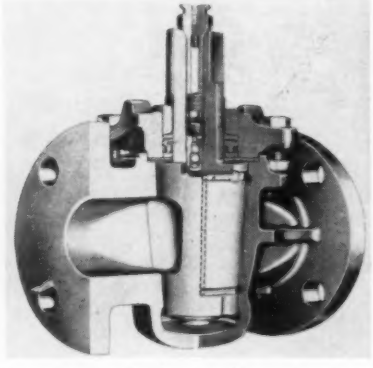
GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 85-86

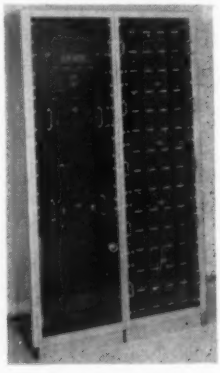
1. Couplings

Dresser Manufacturing is offering improved versions of its Style 38 and Style 39 couplings (GEC-370). Factory preassembled construction provides time and labor saving advantages. Stab-38 and Stab-39 couplings are offered in steel pipe sizes from 2-in. through 12-in ID. Stab-38 is available with either "armored" or plain gaskets.
Dresser Manufacturing Div.



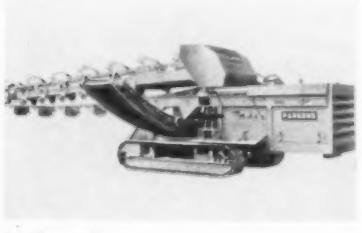
3. Tapered plug valve

Rockwell's Permaturn valves are a new concept in tapered plug valve design (GEC-820). The design utilizes a high lubricity plastic coating that substantially reduces turning and provides lifetime maintenance-free operation. Coating substantially reduces operating torques because of reduction in frictional coefficient.
Rockwell Manufacturing Co.



5. Gas flow system

Datex has a system for monitoring "interruptibles" and recording gas flow from multiple remote stations (GEC-750). The system, SD103, features simplicity, ease of installation, minimum maintenance. Gas flow count is transmitted over commercial telephone lines and centrally displayed on individual 5- or 6-digit counters.
Datex Corp.

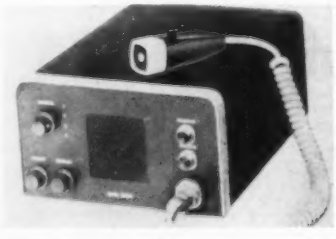


2. Trencher

Parsons is producing a completely new ladder-type Trenchliner for cutting an 18- to 48-in. trench up to 15 feet deep (GEC-210). Model 255 is said to be the largest capacity trencher for its size on the market. It features a low silhouette with only 9-ft 2-in. height and 7-ft 10-in. width outside crawlers.
Parsons Co.

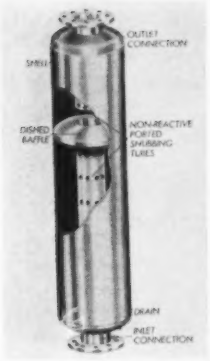
4. Pressure switch

A pressure switch has been introduced by Control Components Div. (GEC-200). The high-performance unit provides simple on-off control at a predetermined pressure. It will operate at pressures from 0.5 psig to 3000 psig. A diaphragm serves as its sensing element and a miniature snap-action switch as its actuating element.
Control Components Div.



6. Two-way radio

Simplicity of operation is featured in the new Hallmark H1-104 two-way radio (GE-140). The radio provides a range of up to 25 miles, depending on terrain and type of installation. A single crystal per channel is employed for both transmitting and receiving. Power consumption: 5.5 amps on 12-v d.c., 55 watts on 115-v a.c.
Hallmark Instruments Corp.

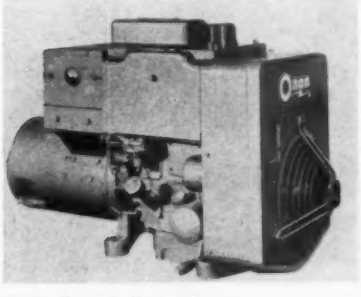


7. Snubbers

Burgess-Manning has developed a new series of snubbers which operate on a straight-flow snubbing principle (GEC-581). They are designed for the new turbo-charged engines. Each one of the new series is designed for a particular level of noise suppression. They are available for 8-in. through 30-in. pipe size. Larger sizes can be built on specification.
Burgess-Manning Co.

8. Commercial water heater

A. O. Smith's Burkay line of commercial water heaters and industrial units now carries a 5-year guarantee (GEC-860). If the copper coil, heat exchanger or burner should fail under terms of the guarantee any time during the five years, Smith provides complete replacement of the faulty part. For storage-type heaters, if the tank should leak at any time during the first three years, a complete replacement heater will be provided.
A. O. Smith Corp.



9. Industrial engines

Onan has introduced the new "J" line of 12 basic engines (GEC-340). The line provides such features as interchangeable parts, choice of gas, gasoline or diesel fueling and water-cooled or air-cooled models—all fabricated from one basic set of tooling. The series includes 1-, 2- and 4-cylinder models ranging from 3 to 15 kilowatts.
Onan Div.

NEW LITERATURE AVAILABLE FROM ADVERTISERS IN THIS ISSUE

(For more information circle Numbers 40 thru 70 on Reader's Service Card)

40. American Meter's Bulletin 402 describes teflon-packed forged steel needle valves (GEC-820).

41. Reliance Regulator Bulletins 123, 150, and 103 describe gas measurement control equipment used at gas engine irrigation installations (GEC-560).

42. Anderson's Bulletin 601 tells how Hi-eF line scrubbers solve dust or liquid separation problems (GEC-720).

43. Atlas Copco has complete literature on its Cobra on-the-spot drilling power (GEC-210).

44. Buflovak Equipment's Catalog 394 presents information on D-SL scrubbers (GEC-720).

45. Empire's room heater sales plan is described in new literature (GEC-420).

46. Fisher Governor's Bulletin PS250A covers the S-254 meter bar regulator (GEC-700).

47. Grove Bulletin's 888-D and 813-B cover gas back-pressure Flexflos and pressure - reducing Flexflos (GEC-700).

48. White Diesel Bulletin 125 covers 2-, 4-, and 6-cylinder, single- or multiple-service compressors (GEC-160).

49. Naugatuck has published a "Gas Installation Handbook" and 16-mm sound color film on Kralastic plastic pipe (GEC-630).

50. Bilco has issued a catalog detailing its sidewalk doors for gas regulator vaults (GEC-060).

51. Republic Steel's X-Tru-Coat is covered in "The Osage Story" and in literature on the plastic-coated steel pipe (GEC 620).

52. Youngstown Steel's Dept. 18-B has complete literature on the company's line pipe (GEC-620).

53. J. I. Case has descriptive literature on its Models 530 and 420 Utility backhoe-loaders and Model 310 Utility crawler backhoe-loader (GEC-210).

54. Midwest's 36-page brochure, "Pipeline Fittings," describes fittings and fabricated piping for pipelines (GEC-370).

55. Nicolet offers full specifications and samples of its pipe protection products (GEC-130).

56. Axelson-Garrett's Bulletin RV describes pressure relief valves ranging from 25 to 6000 psi (GEC-820).

57. Daniel Orifice has published Catalog Section H on its production flow line valves (GEC-820).

58. Foxboro offers Bulletin 7-15A on the T/37 dry flow meter (GEC-560).

59. M. B. Skinner's Folder SSS covers pressure-formed service saddles (GEC-370).

60. American Cast Iron Pipe is offering free illustrated catalog on ductile iron (GEC-620).

61. Norton-McMurray's Catalog 12 presents photos, specs, detail drawings on fittings, cocks, gaskets, meter bars (GEC-370).

62. Roots-Connersville lists the advantages of its new line-mounted Rootsmeters (GEC-560).

63. Johns-Mansville's Dept. G-116 has complete information on Duratape joint wrap (GEC-130).

64. Minnesota Mining offers a free sample roll of its new Scotchrap brand pipe protection tape No. 40 (GEC-130).

65. Armco Drainage offers complete information about Armco pipe for the oil and gas industries (GEC-620).

66. Rockwell offers descriptive literature on its chart timing drive (GEC-750).

67. Black, Sivalls & Bryson's Dept. 1-BQ11 offers details on its desulfurizers (GEC-670).

68. Barton describes its flow recorder in Bulletin 202A-1 (GEC-750).

69. Mullins Dial-O-Graph chart changers are the subject of illustrated literature (GEC-750).

70. Ka-Mo Tools offers Booklet H-140 (GEC-210).

10. Gas ranges

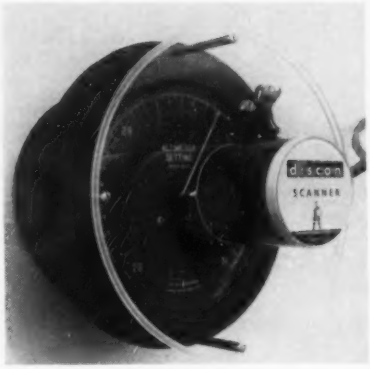
Many new styles, including 36-in. models with 20-in. ovens, are included in the new Vesta gas range line from Athens (GEC-240). The 36-in. models with 20-in. ovens have removable oven door and oven rack runners, double silicone oven door seals, chrome aeration pans, and broiler grill. Ample broiling space is provided by the 20-in. wide broiler.
Athens Stove Works

11. Line printer

Bendix has developed a new high-speed line printer as an accessory for its G-20 computer system (GEC-180). The LP-12 line printer may be used directly with the central processor or accessory equipment without requiring special buffering. Any number of printers may be used with the G-20 system.
Bendix Computer Div.

12. Chain wrench

A new size utility chain wrench from Ridge Tool is designed to accommodate ⅛-in. to 4-in. pipe (GEC-770). It features ratchet-like action in either direction. According to the manufacturer, the C-12's double jaw construction allows the wrench to be operated in either direction without having to remove and refasten it when changing directions.
Ridge Tool Co.



13. Digital converter

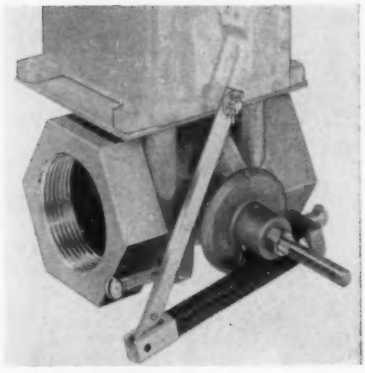
MacLeod Instrument's "Discon" (digital scanner and converter) "reads" dial and pointer instruments, gauges, and meters, and provides a remote digital output (GEC-750). Applications include pressure gauges, flowmeters, thermometers, liquid level gauges, tachometers, etc. Discon also can be used as a simple deviation alarm or "upset" indicator.
MacLeod Instrument Corp.

14. Pipe thread compound

Flexrock's new thread sealing compound, Flexrock 25, is said to have remarkable chemical resistance (GEC-730). The Teflon pipe dope is for use on chrome, chrome plate, nickel, steel, ceramic, and plastic pipe threads, and for joining or connecting dissimilar materials. Its lubricating qualities prevent galled threads and permit easier pipe joining.
Flexrock Co.

15. Check valve

Frank Wheatley has a new and functional check valve with a clapper hinge pin which pivots the clapper out of stream for full pressure and unobstructed passage (GEC-820). The synthetic rubber seal check valve, known as Checkaroo, has a full pipe opening, resulting in 40 per cent less pressure drop across the valve. It is non-lubricated, preventing galling.
Frank Wheatley Pump

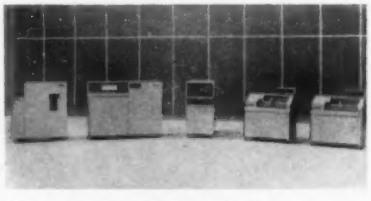


16. Butterfly valve

Mid-Continent's new butterfly valve is suitable for control of either gas or air flow up to 5-psi pressure and with capacities to 20 Mcf/hr natural gas (GEC-820). Either manual or automatic valves are available in seven pipe sizes, 1- through 4-in. It is a low-pressure drop unit with a streamlined, properly sized throat to allow sensitive control.
Mid-Continent Metal Products

17. Tone transmitter

The Quindar QT-17 is a small, compact and complete audio-tone transmitter designed to operate on 117 vac or 12 vdc (GEC-750). It is small enough to mount in most types of impulse duration telemetering transmitters. It can be front-mounted in the telemetering transmitter case. This feature, together with the cable furnished with the unit, permits the ready conversion of most existing telemetering installations to tone transmission.
Quindar Electronics



18. Computing systems

Burroughs Corp. has entered the punched card electronic computer field (GEC-180). Its B200 family of small and medium scale computing systems includes four models. Shown is the B260 which is the basic punched card system. It is described by the company as a "workhorse computer" which will increase productivity significantly in medium and large-scale punched card applications.
Burroughs Corp.

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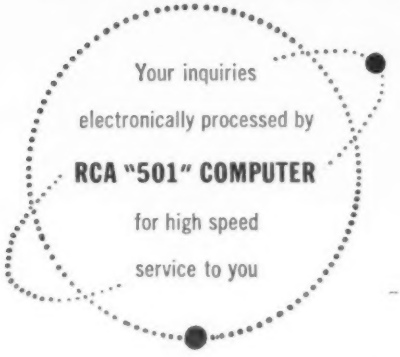

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19. Pipe fittings

Production of the first full line of injection-molded fittings and flanges for new hi-temp Geon thermoplastic pipe has been announced by Tube Turns Plastics (GEC-630). High impact Schedule 40 and 80 fittings and flanges come in ½-through 2-in. pipe sizes.
Tube Turns Plastics

20. Wall furnaces

Williams Furnace has introduced a new series of Forsaire counterflow, gas-fired wall furnaces (GEC-420). They feature the FlexiTemp control system which permits the selection of high or low heat delivery and corresponding blower speed. Heavy-duty, dual centrifugal blowers deliver up to 430 cu ft of warm air per minute.
Williams Furnace Co.

21. Base station antennas

Motorola has a new line of folded coaxial design base station antennas for 136-174 mc two-way radio systems (GEC-140). Three antenna series are included: omnidirectional, cardioid, and unidirectional. Their design eliminates projecting ground plane rods to simplify installation, reduce pattern distortion, and minimize ice damage in cold climates.
Motorola Inc.

TRADE LITERATURE

22. Multi-point gauges

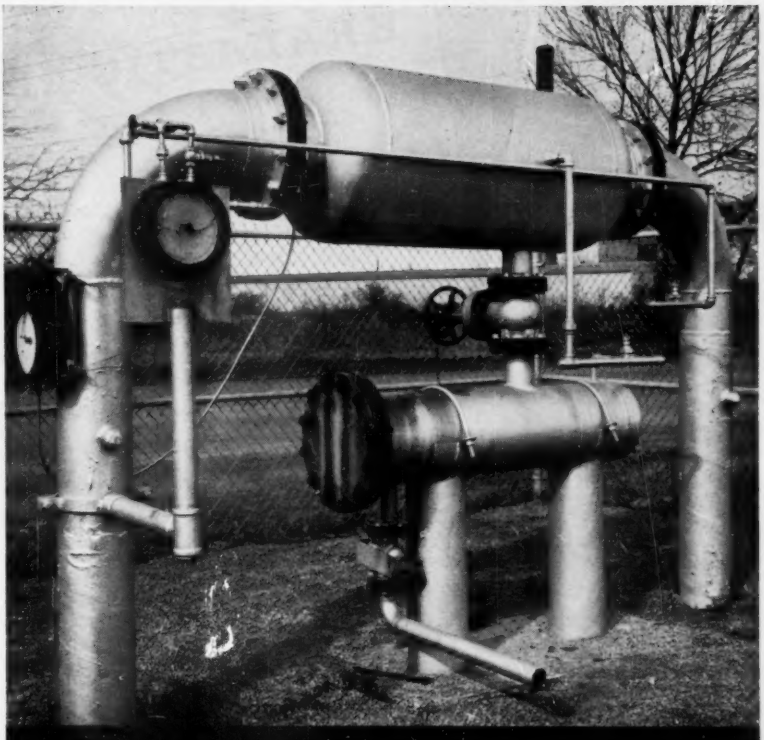
Bulletin 322.11 describes the complete line of Rockwell-Republic multi-point gauges (GEC-540). These gauges are for indicating draft, pressure, differential and temperature.
Republic Flow Meters Co.

23. Packaged compressors

A new bulletin describes Cooper-Bessemer Model AM-2 and AM-4 packaged field compressors (GEC-160). The packaged units are available in more than 25 models, from 100 bhp to 1100 bhp and with discharge pressures up to 6000 psi.
Cooper-Bessemer Corp.

24. Automatic control

Fisher has published a 12-page technical manual on "Generalized Control Theory" (GEC-700). Booklet TM-8 explains with text and many examples the basic theories of automatic fluid control.
Fisher Governor Co.



Problem:

ELIMINATE PILOT and BURNER STOPPAGE

Due to Heavy DUST Accumulation

Solution:

HI-EF GAS LINE SCRUBBER—To prevent pilot and burner stoppage and protect one American 500-B Meter from dust accumulation, a TYPE LDS 12-LP Hi-eF Gas Line Scrubber was installed in a feeder main supplying residential and industrial areas.

Results:

This unique purifier with no moving parts, removed ¼ to 15 quarts of dust per day at 30,000 to 300,000 SCFH of natural gas at 12 to 13 PSIG. Customer complaints ended—dust accumulation ended.

More Information:

Whether your separation problem be dust or liquid, there's a Hi-eF Gas Line Scrubber to meet your requirements. Write for Bulletin 601 or ask for an Anderson Engineer to call.

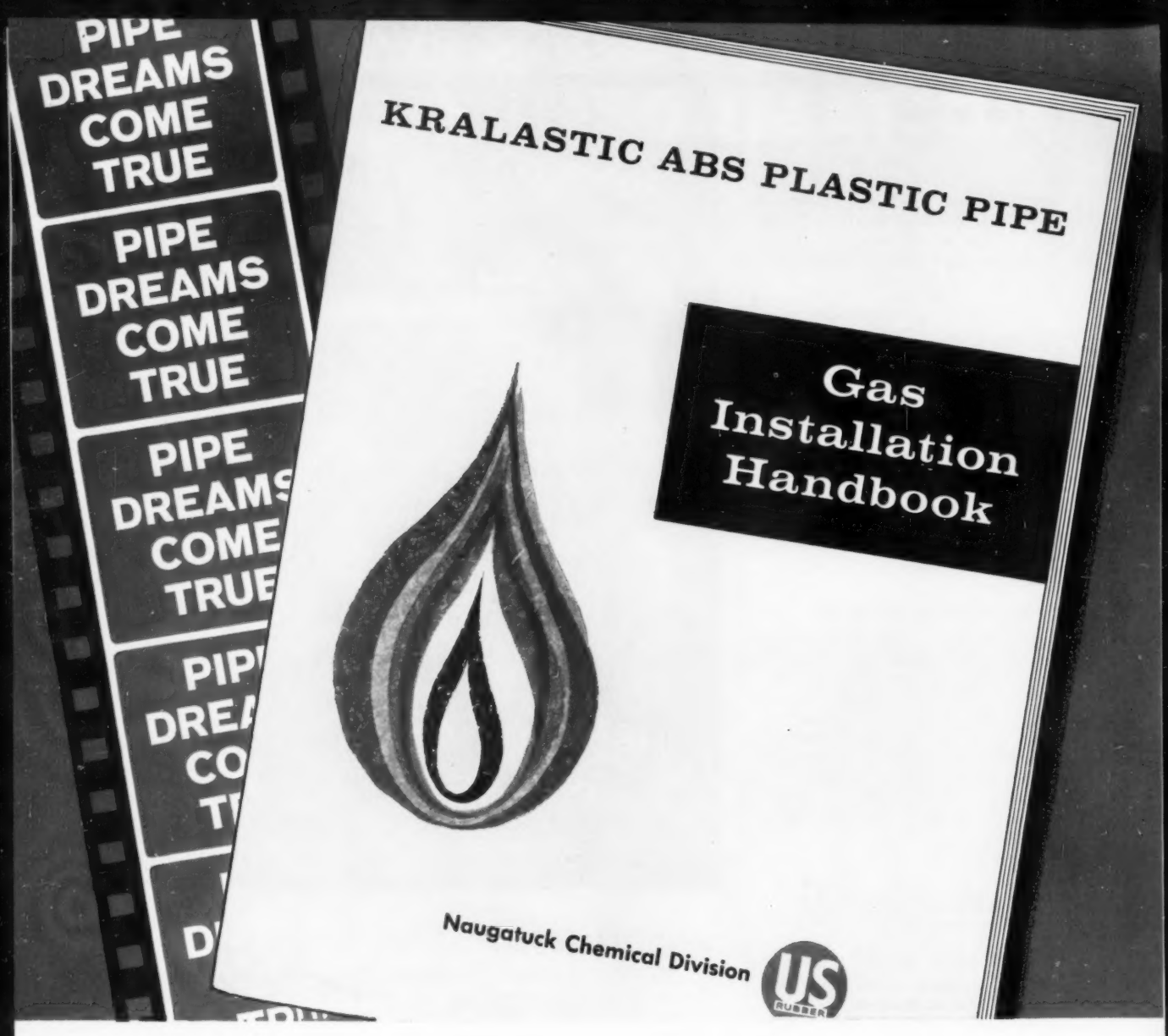
Hi-eF PURIFIER

By the Manufacturers of Super-Silvertop Steam Traps

THE V.D. ANDERSON COMPANY

Division of International Basic Economy Corporation

1981 West 96th Street Cleveland 2, Ohio



KRALASTIC Pipe Film... and Gas Handbook!

See why Kralastic® ABS pipe has been used in more than 16,000 miles of successful installations during the past 12 years.

PIPE DREAMS COME TRUE: A 16 mm sound color film featuring the definite proven advantages of Kralastic ABS pipe for oil-field gathering lines, potable water transmission, natural gas lines, domestic service, electrical conduit. Shows actual step-by-step installation shots. Illustrates, for first time, a new Emergency Gas Control System developed by Arizona Public Service Company.

GAS INSTALLATION HANDBOOK... Describes installation and joining techniques; "hot" and "cold" tapping methods; compares pipe prices; gives size and working pressure recommendations, flow tables, physical properties, emergency control procedures; presents recommended specifications for engineering and purchasing departments. Invaluable information for all pipe users.

Contact nearest Kralastic ABS Pipe Manufacturer for Gas Handbook and free use of film.

NAUGATUCK CHEMICAL DIVISION US RUBBER **United States Rubber**

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Arizona Plastic Extrusion Company
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Southwestern Plastic Pipe Co. of Arizona
1837 West Roosevelt, Phoenix

CALIFORNIA
Amco Plastic Pipe Company
2002 Davis Street, San Leandro
Baldwin Extruded Products
12200 Woodruff Avenue, Downey
Lasco Industries, Inc.
1561 Chapin Road, Montebello
Sloane Manufacturing Company
7606 North Clybourn Avenue, Sun Valley

CONNECTICUT
Anaconda American Brass Company
414 Meadow Street, Waterbury 20

FLORIDA
Plastiline, Incorporated
1251 N. E. 48th Street, Pompano

ILLINOIS
Anesite Company
3575 Touhy Avenue, Chicago 45

INDIANA
Chase Brass & Copper Company, Inc.
1609 Oliver Avenue, Indianapolis 21
Crescent Plastics, Inc.
955 Diamond Avenue, Evansville 7

MASSACHUSETTS
Plymouth Cordage Company, Plymouth

NEBRASKA
Western Plastics Company
1515 West Second Street, Hastings

NEW JERSEY
American Hard Rubber Company
Ace Road, Butler
Triangle Conduit & Cable Co., Inc.
Triangle and Jersey Aves., New Brunswick

OHIO
The Evanite Plastic Company
Division of The Evans Pipe Company
RD 4, Carrollton
The Plastex Company
3232 Cleveland Avenue, Columbus 24
Republic Steel Corporation
Republic Building, Cleveland 1
Yardley Plastics Company
142 Parsons Avenue, Columbus 15

TEXAS
Southwestern Plastic Pipe Company
P.O. Box 117, Mineral Wells

WASHINGTON
Portco Corporation
Paper and Plastic Division, Vancouver
Western Plastics Corporation
3110 Ruston Way, Tacoma 2

United States Rubber
NAUGATUCK CHEMICAL DIVISION
Naugatuck, Connecticut

TRADE LITERATURE

25. Boring unit

The Ka-Mo G-160, a gasoline-powered boring unit, is covered in a new bulletin (GEC-210). The G-160 boring range varies from 200 ft of 12-in. diameter hole to 150 ft of 36-in. hole on the horizontal or at angles up to 30 deg. from the horizontal.
Kwik-Mix Co.

26. Epoxy pipe

Fibercast Co. has published a technical and specification data catalog on its epoxy pipe (GEC-630). Described are the high strength, high temperature, corrosion resistant characteristics of Fibercast pipe.
Fibercast Co.

27. Computing system

A 6-page brochure from Bendix illustrates the hardware, software and service features of the G-20 computing system (GEC-180). The brochure describes the over-all system, showing each component, including the G-20's control buffer and data communicator.
Bendix Computer Div.

28. Pump line

Allis-Chalmers complete expanded pump line is described in a 1008-page Pic-A-Pump catalog (GEC-660). Engineering data are arranged for selection of centrifugal, axial or mixed flow pumps best suited to individual and specific applications.
Allis-Chalmers Mfg. Co.

29. Radio record

Motorola has produced a record that demonstrates the dramatic difference in message clarity when impulse noise suppression is built into a two-way radio (GEC-140).
Motorola Inc.

30. Analogger

Publication 201.11 describes the Rockwell-Republic MP-12 analogger (GEC-750). Design data and operating benefits are discussed in the 8-page bulletin.
Republic Flow Meters Co.

31. Control valve

A new 8-page catalog, DCV-1, shows OPW-Jordan's complete line of controls valves from ¼- to 6-in. sizes (GEC-820).
OPW-Jordan Corp.

32. Furnace line

Sequoia has released two new bulletins on its "Golden Line of the 60's" (GEC-420). A 4-page data sheet describes the company's horizontal, forced air gas furnace line.
Sequoia Manufacturing Co.

33. Pumps, boosters

The Leiman line of rotary vacuum pumps, pressure pumps, gas boosters and accessories is covered in a 16-page bulletin (GEC-660).
Leiman Bros. Inc.

34. Heat processing

Selas' Bulletin DB-2 on its Duradiant burners presents a full line of "complete premix" radiant type gas units (GEC-080).
Selas Corp.

35. Off-the-road vehicle

A 2-page bulletin describes the new Cushman Haulster (GEC-790). This is a utility vehicle for off-the-road jobs.
Cushman Motors

36 Ball valve

Lunkenheimer's Type 316 stainless steel ball valve is discussed in Bulletin 612 (GEC-820). The valve is designed for corrosive fluids, gases, and general corrosive services.
Lunkenheimer Co.

37. Strip-scale receiver

Bristol's Series 654 Metagraphic pneumatic receiver is a strip-scale indicating receiver which can be used as a single unit or gang assembled for either horizontal or vertical mounting (GEC-750). It is described in new Product Data A113.1.310.
Bristol Co.

38. Explosion-proof motors

Bulletin 1000 CD describes the Leland Ohio Electric line of integral-hp, explosion-proof a.c. motors (GEC-580). The motors range from 1 through 5 hp.
Leland Ohio Electric Co.

39. Direct-fired heaters

"Industrial applications of direct-fired gas heaters are discussed in 8-page bulletin GN-200 from Reznor (GEC-410).
Reznor Manufacturing Co.

Twin mobile displays tour country

Two complete lines of products for the gas industry are touring the nation's gas utilities. The twin mobile display trucks (see photo), designed and outfitted for Rockwell Manufacturing Co., replace last year's single display.

One of the units covers utilities located east of the Mississippi; the other is concentrating on areas to the west.

Included in each display are cutaway models of each size Rockwell gas meter, several with commonly used accessories, and a standard LPG meter. One of these models, a 5000-cu ft meter, is mechanically driven to simulate actual operation.

AGA issues odorant study

"Soil Adsorption of Odorant Compounds" is the title of a research program sponsored by AGA's PAR Plan and conducted by IGT.

The study was made to determine the extent of removal of representative odorant compounds for natural gas by selected soil constituents of controlled moisture content. It is indicated that the effects of odorant properties are relatively minor compared to the effects of field variables.

Additional information or copies of Research Bulletin No. 33 ($3.50 per copy) are available from AGA.

Lone Star's gas light promotion big success

An average sale of one gas light for each of Lone Star Gas Co.'s 6000 employees was recorded on Gas Light Day, a recent promotional campaign.

All employees were divided into sales teams with a team captain designated to distribute material, present a sales pitch and answer questions. Each team was given a quota of 10 contacts to be made by each team member. No individual prizes were awarded, but the team received cash awards for each gas light sold, provided the team quota for contacts was made.

To build up enthusiasm for the campaign, a special price for employee purchase of the gas lights was announced in advance. Terms as low as $2 a month with nothing down were offered all customers. Purchase of more than one gas light also was encouraged by offering the second gas light during the campaign at half price when it was installed at the same address.

NOW 2 ARKLA GAS METERS

V-175—175 cu. ft./hr. capacity
V-250—250 cu. ft./hr. capacity

WE NOW MAKE TWO Arkla Gas Meter models . . . they look alike, and *are* alike, except for the capacity. Same fine workmanship, same lasting, corrosion-proof finish . . . and most important: *Extremely accurate!*
Order Arkla Gas Meters today.

ARKLA

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NEW ALL-WEATHER "SCOTCHRAP" BRAND PIPE PROTECTION TAPE NO. 40

Now—an all-season tape that handles the toughest jobs. Ideal for field-wrapping under cold weather and other adverse climatic conditions. Provides excellent insulation properties and improved electric strength; resists acids, alkalies, salts, oils, gasoline and naphtha. Try it yourself and see . . . send in the coupon below for your free 9-foot sample roll.

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3M Co., Dept. EBU-110, 900 Bush Ave., St. Paul 6, Minn.
Send me my free sample roll of your new all-weather "SCOTCHRAP" BRAND Pipe Protection Tape No. 40.

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HEAVY DUTY
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WRENCHES
with the "work" and "feel" you expect from REED pipe tools!

THESE NEW HEAVY DUTY WRENCHES ARE DESIGNED TO REED STANDARDS OF TOUGHNESS, LONG SERVICE, AND SMOOTH, EASY USE.

Pearlitic malleable handle and housing are designed with heavy sections at the stress points, without sacrificing lightness and "feel."

•

Calibrated hook jaws are drop forged, milled and triple heat treated for toughness and long wear.

•

The patented double-spring action lets you grip and ratchet faster and with less lost motion.

•

Regular models in all lengths from 6" to 48". Offset design (for hard-to-reach corners) in 8", 10", 14" and 18".

•

Both designs meet or exceed Federal Specifications GGG—651c, Type 11, Class A.

See these new Reed Wrenches at your Jobber.
BUY them to save time, money and trouble.

REED MANUFACTURING COMPANY
Erie, Pennsylvania

NI-Gas eliminates odor of atmospheric bleed gas

Joe Becia, Northern Illinois Gas Co. engineer, has devised a method of deodorizing atmospheric bleed gas at NI-Gas stations (see photo). For his effort to boost public relations with residents, Becia received a $70 award from the company.

Beginning with a vapor-proof light fixture, Becia removed the receptacle and replaced it with a wick. The fixture is filled with a liquid solution—one part of an aromatic oil called "Neutroleum Gamma" and nine parts of kerosene or No. 1 fuel oil—and inserted into the gas stream. The gas, passing over the wick, is deodorized.

The unit is easily standardized and replacement parts are readily available. Hook-up is simple—it is tapped with ¾-in. pipe taps on four sides.

Peoples Gas completes 2nd phase of system

Peoples Gas Light & Coke Co., Chicago, has completed work on the southern section of its new $20 million interstation gas main, marking completion of this year's construction program.

The first 8-mile segment was constructed on Chicago's north side last year. The third, or central, section to connect the other two is slated for installation next year.

When finished, the new line will intersect other gas mains and will interconnect with pumping stations of Peoples Gas' distribution system. It will boost the system capacity and permit greater flexibility in meeting peak heating demands.

Wathen heads N.J. gasmen

Hugh L. Wathen, vice president of South Jersey Gas Co., is the newly elected president of the New Jersey Gas Association. He succeeds W. D. Williams of New Jersey Natural Gas Co.

Other new officers are Calvin R. Carver, City Gas Co., 1st vice president; Ernest F. Weeks, Public Service Electric & Gas Co., 2nd vice president; and Walter C. Money, Elizabethtown Consolidated Gas Co., secretary-treasurer.

Columbus, Ga., joins Century Club

Union Major General James H. Wilson's Raiders almost spoiled the induction ceremony of the city of Columbus, Ga., into the Century Club of the Cast Iron Pipe Research Association. The general's troops destroyed the city's records during the last battle of the Civil War at Columbus in April 1865. With the city records was the service record of the installation of the cast iron gas main, still serving Columbus today.

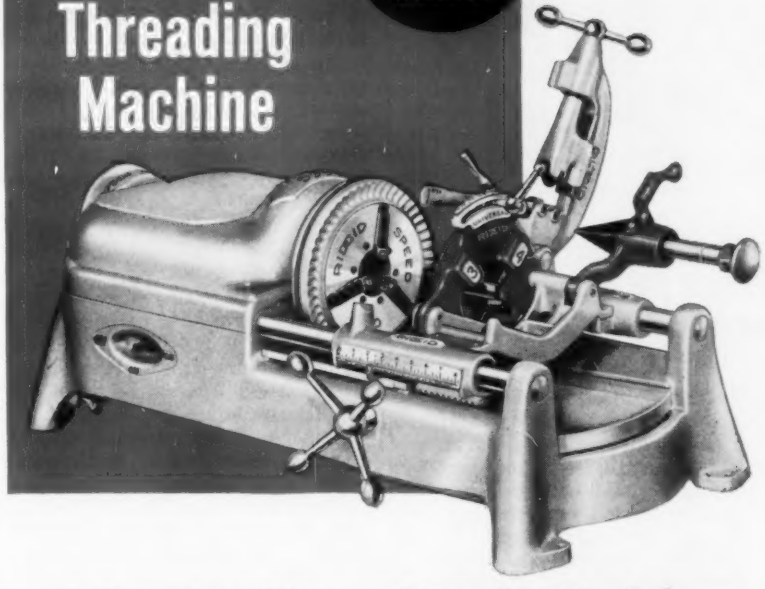
Officials, however, determined that the pipe was over 100 years old. The reason: When they dug up some pipe, they found it was made with a "square-shoulder bell," the method used 100 years ago.

So, the induction ceremony did take place with Don Harrington (at left in photo), representing the Cast Iron Pipe Research Association, presenting the Century Club certificate to Jack M. Averett (in ditch), Gas Light Co. supervisor.

The pipe shown in the photo is believed to have been installed in 1854. The oldest piping still in use was used then to connect the old gas lamps that illuminated downtown Columbus.

Pays for itself fast... in labor savings alone!

RIDGID 535 Pipe & Bolt Threading Machine



A Complete Pipe and Conduit Workshop At Your Finger Tips... For High-Speed Threading, Cutting, Reaming

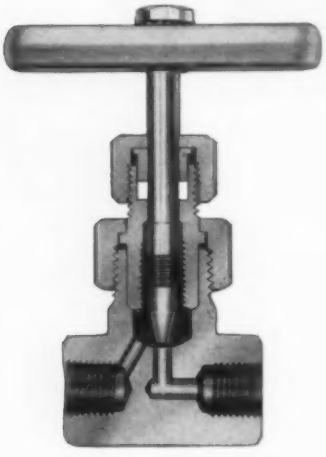
Full 2" capacity. Plenty of power for up to 12" geared tools. Universal Die Head included threads ½" to 2" pipe and conduit with just two sets of dies. Four other styles of heads available... ⅛" to 2" pipe or conduit, ¼" to 2" bolts. Fast hand-action RIDGID Speed Chuck. Cam-Action Rear-Centering Workholder. Automatic re-circulating oil system. Easy-to-Read Length Gauge.

See and Try This Time and Cost-Saving RIDGID 535 at Your Supply House Today

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

AMERICAN® NEEDLE VALVES



Handle the toughest meter manifold jobs and corrosive field services. Eliminate gland leaks.

Teflon-packed forged steel American Needle Valves stand up under all conditions. Stainless or carbon steel precision-machined valve bodies are ideally suited for welding. Stainless steel centerless-ground valve stem simplifies valve repacking under pressure.

Standard valves design-rated for pressures to 5,000 psi at 70°F. Hydrostatically tested to 10,000 psi (twice rated working pressure) and individually inspected on request. Furnished with graphite-impregnated asbestos packing for temperatures above 450°F. Angle or straight patterns — screwed or union bonnets.

Write for Bulletin 420.

AMERICAN METER COMPANY

Sales Offices in Principal Cities

Arizona PSCo showcases appliances in Phoenix

Arizona Public Service Co. believes it scored a first in the gas industry recently when it opened a gas appliance showcase in Phoenix's newest and largest shopping center.

In addition to more than 50 separate stores, the $20 million Chris-Town regional shopping center features a 1000-ft enclosed air conditioned mall.

The Gas Appliance Showcase (GAS) fills a long-felt need in Phoenix. "The showcase is just what the word says," according to Arizona's PSCo.'s Keith Winston, manager of the store. "It's a place to show the public all the latest gas appliances available . . ."

Arizona Public Service doesn't directly merchandise appliances; actual sales are made from some 14 showcase dealers in the Phoenix area. The utility's three employees at the store take orders and down payments for the dealers.

The 25-ft wide, 60-ft long showcase is divided into three sections (see photo). Front area of the store displays competitive appliances in operation. In the middle of the store is an ultramodern all-gas kitchen, featuring built-in range, built-in oven, dishwasher (the first gas-operated unit to be displayed in Arizona), refrigerator-freezer unit, and a barbecue unit.

A home service adviser is available to explain and demonstrate appliances.

In addition to the kitchen appliances, outdoor gas lights, incinerators, hot water and space heaters, air conditioning units, and other gas appliances will be displayed.

The store itself is heated and cooled by two remote gas air conditioning units.

Winston said that more than 10,000 people visited the store during the first three opening days. Since then, about 600 prospects have visited the showcase daily.

Jones Furnace Co., Holland, Mich., and General Products Co. Inc., Fredericksburg, Va., are newly elected members of the Gas Appliance Manufacturers Association.

OIC valves will be manufactured in Mexico, according to Wayne Young, president of Ohio Injector Co., Wadsworth, Ohio.

Ford Motor Co. plans to purchase assets of Philco Corp., Philadelphia. Under the plan, the present Philco organization, including personnel and facilities, will become a wholly owned subsidiary of Ford, which plans to continue business activities of Philco without interruption.

A study of the effect of surface coatings on the behavior of materials is being conducted at the Martin Co.'s Research Institute for Advance Study.

Caloric Appliance Corp. has changed its name to Caloric Corp., reflecting the company's current diversification of product lines.

California's investigation of the natural gas situation in the state will be launched the first week in December. Natural gas production is the subject of the first phase of the investigation.

GAS·PEOPLE

Dr. H. R. Linden
IGT

S. J. Northrop
American Meter

DR. HENRY R. LINDEN is now a director of the Institute of Gas Technology, Chicago succeeding DR. MARTIN A. ELLIOTT who was named academic vice president of Illinois Institute of Technology.

WILLIAM C. FRENCH, JR. is now vice president—sales for United States Steel's National Tube division, Los Angeles, with ARTHUR J. ELBERT, JR. succeeding French as general manager—sales.

STUART MEYER is now vice president in charge of engineering for the Hammarlund Manufacturing Co. Inc., New York.

ROBERT O. KOCH is vice president and general counsel of Texas Gas Transmission Corp., Owensboro, Ky. and MELVIN H. RATTRAY, JR. is manager of rates.

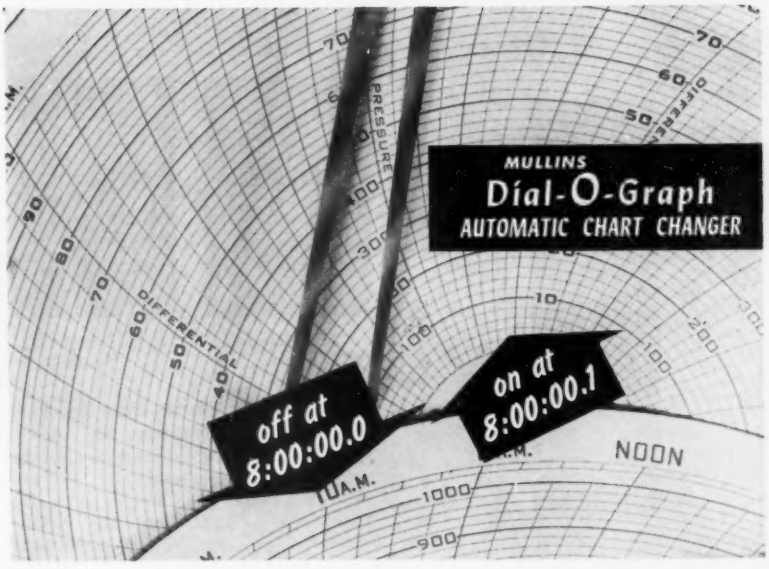
STUART J. NORTHRUP is director of manufacturing for American Meter Co., Erie, Pa.

GUSSIE OGLESBY JONES with Atlanta (Ga.) Gas Light Co. since 1929, retired. Miss Jones made many contributions to advertising in Atlanta and to utility advertising on the national level.

N. J. HATTER to sales representative with Fisher Governor Co., Marshalltown, Iowa covering northern California and western Nevada.

R. O. Koch
Texas Gas

M. H. Rattray Jr.
Texas Gas

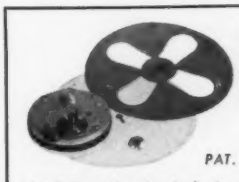


Elapsed time to change charts $\frac{1}{10}$-sec.!

The fastest, most efficient and dependable chart changer available . . . allows recorders to operate unattended . . . allows every recorder in your plant or system to be correlated to the same chart change time.

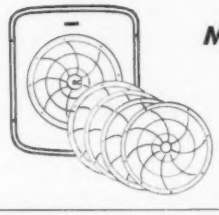
- Charts dial off instantly, no interruption of recording
- Adapts to any make, model, or type of recorder
- Field-proven . . . long used by most major gas companies
- Does not effect operation or appearance of recorder
- Charts handle, stack, and integrate as usual
- Current chart is always in view; completed charts are safely stored chronologically in chart catcher under recorder
- Capacity up to 50 charts in one loading

Write for illustrated literature with full details and prices. No obligation.



PAT.

Dial-O-Graph is a simple, 3-piece attachment—Dial, Chart Plate, and Chart Drive (Mac-Nick)—that fits all recorders. Charts are slotted only in center margin . . . same pattern for all instruments, all change times. (Not shown is transparent guide plate and metal chart catcher for storage of completed charts.)



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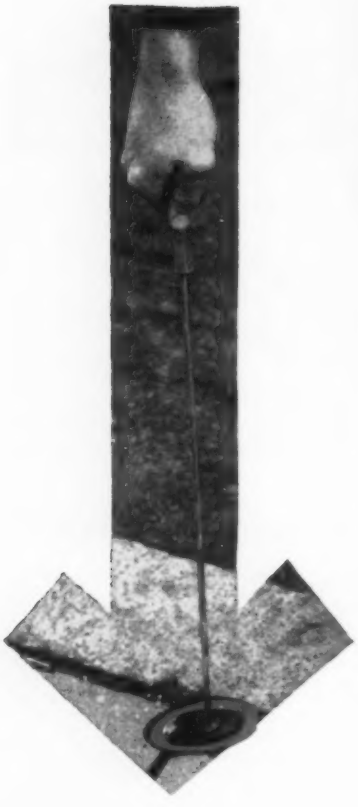

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Survey Consultants

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J. S. Wolfe
Norge

J. D. Dougherty
Norge

ORVILLE R. MERTZ, financial vice president and treasurer of Koehring Co., Milwaukee, was elected to the board of directors.

Dresser Manufacturing Division, Bradford, Pa. appointed CHARLES I. GILMER as sales representative in the Rocky Mountain states.

JAMES D. DOUGHERTY is general sales manager, domestic appliances for the Norge division of Borg-Warner Corp. headquartering in Chicago, while JOHN S. WOLFE becomes field sales manager. WALTER C. FISHER resigned as vice president of sales.

ARCH A. SPROUL was elected to the board of directors of The Columbia Gas System, Inc., New York.

JAMES B. HENDERSON of Houston is now executive vice president of Transcontinental Gas Pipe Line Corp. and will continue on the board of directors.

CARL A. HIESTER is now assistant advertising manager of Pennsalt Chemicals Corp., Philadelphia, replacing RICHARD S. LEE who transferred to the Industrial Chemicals division.

B. C. MCKNIGHT has transferred to the Dallas office of Daniel Orifice Fitting Co. as district sales representative.

B. C. McKnight
Daniel Orifice

J. B. Henderson
Transco

WELDED STEELCASE METERS

For Long-Term Savings

- Low first costs
- Major repairs eliminated
- Minor adjustments easy to make
- Lowest cost per year of service
- Exceptional outdoor durability
- Compact, light-weight installations
- Rugged pressed steel construction
- Sustained measurement accuracy
- Capacities from 75 to 300 cfh

Ask your American representative about the full line of Welded Steelcase Meters and their many advantages for all fuel gas services. See Bulletin 304 for complete details.

AMERICAN METER COMPANY

Sales Offices in Principal Cities

Two merchandising managers for Norge division of Borg-Warner Corp., are HARRY G. MCDAVITT and RICHARD C. LARKO.

CHARLES J. RANDOLPH, JR. is now engineering manager of the chemical division of United Engineers & Constructors Inc., Philadelphia.

MAX A. CORETH is now manager of the international marketing division of Robertshaw-Fulton, Richmond, with EUGENE R. GELFO as sales promotion manager for the Thermostat division in Youngwood, Pa.

CARL J. BARTOSESKI to manager, Paricode Systems of Electronetics division, North Electric Co., Galion, Ohio.

WILLIAM G. HILL is now sales manager directing North Carolina Natural Gas Corp., is campaigning for new customer acquisition in Fayetteville, N. C.

DARREL D. BYERLEY is general sales manager of Tinker & Rasor's new Detectron division, San Gabriel, Calif.

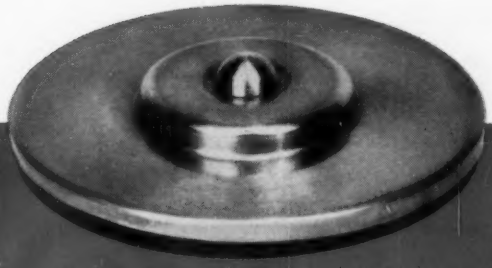
D. D. Byerley
Tinker & Rasor

E. R. Gelfo
Robertshaw

C. J. Bartoseski
North Electric

AN ORIGINAL
LANCASTER DEVELOPMENT

Lancaster
VALVE
COVER



Glides over valve seat with a feather lightness for maximum life and minimum friction.

a meter is only as accurate as its parts

- **Life-long performance** with gum-resistant friction-free carbon-graphite ring.
- **Micro-finish lapped surface** for minimum friction co-efficients.
- **Complete protection** for top and sides of ring with heavy gauge brass shell.
- **Extra thickness** of brass shell prevents bent or distorted valve crank stud.
- **Superior contact** in any driving dog position with extra long sturdy nickel-silver stud.

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THE FLOW RECORDER YOU CAN COUNT ON

Absolute dependability, under the most demanding operating environments—that's the promise and the performance of the Barton 202A flow recorder. Thoroughly proven in the gas production fields, the 202A is enjoying ever-increasing popularity in gas transmission and distribution systems. It is compact and ruggedly built, not subject to the usual frailties of such a precise instrument; it has built-in overrange protection, which allows it to maintain calibration under wide pressure fluctuations; it is immune to condensate problems, making it ideal for application in all geographical areas. A recently added bonus: the 202A can be fitted with the new Barton chart changer which allows the instrument to record continuously and unattended, for up to 16 days, using a fresh chart each day. For complete information and specifications on the 202A flow recorder, request Bulletin 202A-1.

BARTON

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BARTON INSTRUMENT CORPORATION • MONTEREY PARK, CALIFORNIA

PEOPLE

ROBERT F. GILKESON is vice president in charge of engineering and research for Philadelphia (Pa.) Electric Co.

Minneapolis-Honeywell's Electronic Data Processing division, New York, appointed three special industry representatives: J. NICHOLAS BURNS, insurance; JACK E. DALTON, textiles; and ROBERT AUFDERHAR, public utilities.

Two sales engineers for Grove Valve & Regulator Co., Oakland, Calif., are GEORGE H. LOEFFLER and M. L. WHEAT, both headquartered in Houston.

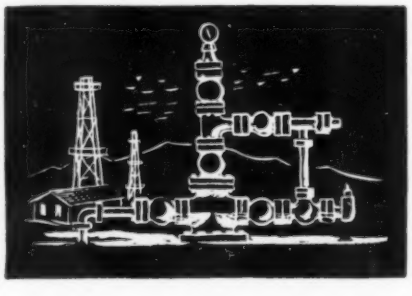
HUGH C. SUTHERLAND retires after nearly 20 years with Great Falls (Mont.) Gas Co.

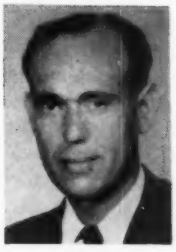
RICHARD R. GRAY is now general engineer in the production department of Ohio Fuel Gas Co., with headquarters in Columbus. RAY W. SPIREK was promoted to Wellington manager. JUSTINE SZALWINSKI is home service adviser in Mansfield.

RICHARD T. WAITS JR. becomes eastern regional industrial manager headquartering in Long Island City succeeding D. W. FRYBACK who becomes account executive, both with Minneapolis-Honeywell Regulator Co.

HAROLD MCGRATH has joined AGA in New York as special service representative replacing CHET WEGENER who resigned.

Minneapolis-Honeywell Regulator Co., New York announces these changes: JOSEPH A. BOWMAN to utilities market manager in Philadelphia; GEORGE S. RABB, branch sales manager at Buffalo; WILLIAM B. WELLS, branch sales manager in Dayton, Ohio; JACK W. LARSEN, branch sales manager at Cincinnati succeeding RALPH A. LEWTAS, now training coordinator and application engineer headquartering in Cleveland.





E. G. Warshafsky
NEES

H. L. Pratt
NEES

T. H. Rennell Jr.
NEES

A. W. Farley
NEES

New appointments with New England Electric System, gas division are: ERNEST G. WARSHAFSKY to distribution engineer replacing HAROLD L. PRATT, now assistant to the general superintendent of North Shore Gas Co. in Salem. Other changes include: THOMAS H. RENNELL, JR. to chief gas engineer succeeding HERBERT C. JONES retired, and ARTHUR W. FARLEY as engineer.

ERNEST H. HUNDERTMARK was promoted to senior engineer, gas measurement and regulation for Peoples Natural Gas Co., Pittsburgh.

New appointments at Clark Bros. Co., division of Dresser Industries, Inc., include: CHARLES P. CLARK, JR. in charge of the new Buffalo office; four new sales engineers are: M. S. KANADY, Amarillo; Z. B. DEER, Tulsa; EDWARD S. LEONARD, Houston; THOMAS R. BETT, Shreveport.

Three additions to Information Systems, Inc., Los Angeles are: DR. DAVID B. BRANDON, manager, process control department; JOHN W. CANNON, systems project manager; and FRANCIS V. LYLE, manager, programming and analysis department.

PETER S. BARNO was elected vice president of employee and public relations of Worthington Corp., Harrison, N. J., and ED B. HUNTER was appointed manager of production planning and material control.

JAMES W. KNOWLES is now assistant pipeline superintendent for the trunk line system of Alberta Gas Trunk Line Co. Ltd., headquartering in Calgary.

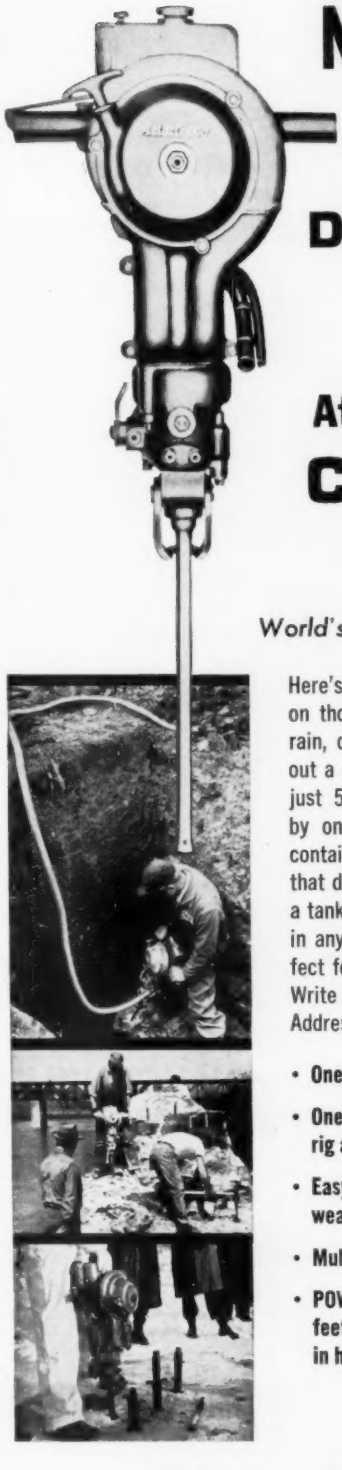
ROGER A. SCOTT joined The Cooper-Bessemer Corp. of Mount Vernon, Ohio as an attorney in the administrative department.

Roots-Connersville Blower, division of Dresser Industries, has opened a new office in Midland, Texas with LEROY C. LAYCOCK as manager.

Deaths

EDWARD S. BIGELO, a market analyst for Brown Instruments division of Minneapolis-Honeywell Regulator Co., New York after a long illness.

ELEANOR MORRISON, home service director for Michigan Consolidated Gas Co.'s Grand Rapids district, drowned in Lake Michigan.



Now! Get ON-THE SPOT DRILLING POWER ... with Atlas Copco's COBRA!

World's lightest motor drill!

Here's a drill you use to fill in on those jobs where cost, terrain, or time prohibits sending out a compressor crew. Weighs just 53 pounds; easily carried by one man. Completely self-contained with gasoline engine that drills 50-60 feet of hole on a tankload (2 qts.) of fuel. Drills in any position up to 45°. Perfect for light drilling anywhere. Write for complete literature. Address: Dept. GM-7

- **One-man operation!**
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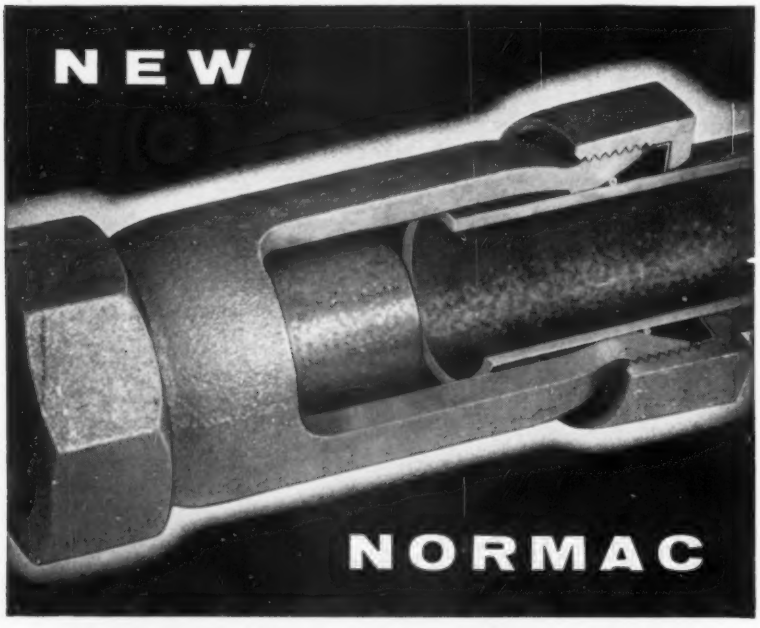
REGULATORY TRENDS

Continued from page 12

the homiletics for novitiates, although, so far as conveniently it can be, it is covered by an innocent terminology, designed to prevent its disclosure. Our democracy, like any other, must meet that faith and that creed on the merits, or it will perish; and we must not flinch at the challenge. Nevertheless, we may insist that the rules of the game be observed, and the rules confine the conflict to weapons drawn from the universe of discourse. The advocacy of violence may, or may not, fail; but in neither case can there be any 'right' to use it. Revolutions are often 'right,' but a 'right of revolution' is a contradiction in terms, for a society which acknowledged it, could not stop at tolerating conspiracies to overthrow it, but must include their execution. The question before us, and the only one, is how long a government, having discovered such a conspiracy, must wait. When does the conspiracy become a 'present danger'? The jury has found that the conspirators will strike as soon as success seems possible, and obviously, no one in his senses would strike sooner. Meanwhile they claim the constitutional privilege of going on indoctrinating their pupils, preparing increasing numbers to pledge themselves to the crusade, and awaiting the moment when we may be so far extended by foreign engagements, so far divided in counsel, or so far in industrial or financial straits, that the chance seems worth trying. That position presupposes that the Amendment assures them freedom for all preparatory steps and in the end the choice of initiative, dependent upon that moment when they believe us, who must await the blow, to be worst prepared to receive it." * * *

"True, we must not forget our own faith; we must be sensitive to the dangers that lurk in any choice; but choose we must, and shall be silly dupes if we forget that again and again in the past 30 years, just such preparations in other countries have aided to supplant existing governments, when the time was ripe. Nothing short of a revived doctrine of *laissez faire*, which would have amazed even the Manchester School at its apogee, can fail to realize that such a conspiracy creates a danger of the utmost gravity and of enough probability to justify its suppression. We hold that it is a danger 'clear and present.'"

Judge Hand had foresight in ruling 10 years ago that the clear and present danger of Communism could be countered by Congress without violating the Amendment to our Constitution that guarantees freedom of speech. ■



MODERNIZED Extra Heavy Wall All-Malleable COUPLING Provides More Deflection Than Ever

Engineered in line with latest data on distribution pressures and installation ease. Inspect its construction and quality materials in detail. (Available with Normac INSULATING gaskets).

BRASS FITTINGS
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Maximum stab. All sizes, with or without insulating gaskets. Also in brass 1¼ I.P.S.

BRASS FITTINGS
The most complete line for copper or plastic tubing in ⅝, ⅞, 1⅛, 1⅜ O.D., 1¼ I.P.S.

Top Quality for 22 Years in Gas Distribution Equipment

Get helpful CATALOG 12. Photos, specs, detail drawings & much helpful data for modernizing or new installations.

PERMANENCY Rely on NORTON-McMURRAY for the finest! NORMAC continues to modernize and improve couplings and fittings in step with latest gas distribution demands. 22 years experience concentrated on ONE purpose . . . the BEST! Today, major gas distribution companies say "NORMAC" to define their standard of quality.

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WASHINGTON

Continued from page 25

ducers in a recent ruling by Hearing Examiner Joseph Zwerdling. In the ruling, Zwerdling rejected 15 annual rate increases totaling $2.8 million by Tidewater Oil Co. It is the second major rate case ruling since the 1954 Supreme Court decision giving the commission control of producer prices.

He used the cost-of-service method set by the commission in the

earlier Phillips case. The examiner rejected Tidewater's proposed higher rates and ordered refunds of all higher rates which were collected under bond. He said the area-pricing approach came too late to be used.

Warning smoke remains after adjournment

THE nation's lawmakers have gone home for their annual fence-mending exercises, leaving behind a strong odor of warning smoke for the gas industry.

As expected, Senate and House members—after a mild revolt early in the year—were made to understand the logic of many of President Kennedy's domestic programs and policies, and fell into line rather well. As far as the gas industry is concerned, they fell in line all the way.

Nothing disastrous resulted, but some serious first steps were taken to what could be dangerous trends for the industry.

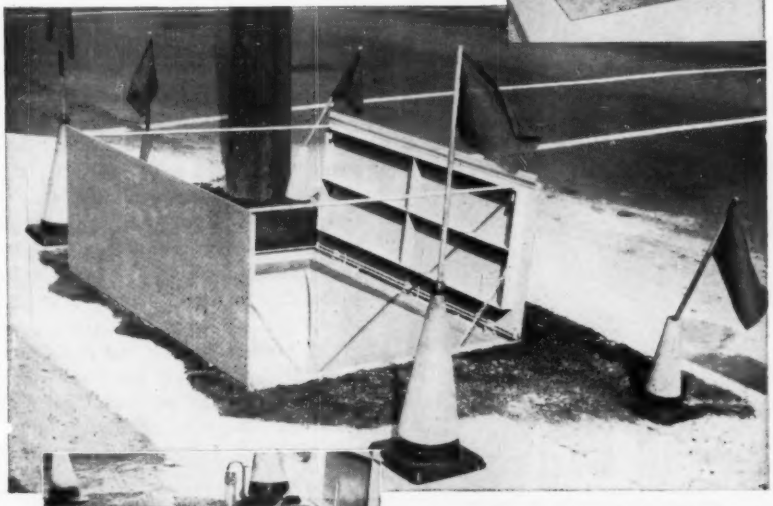
A postmortem of the nine months of congressional deliberations, from the gas industry's point of view, bares several signposts pointing toward even deeper governmental interference with the industry.

• *Nominations*—The Senate, after a couple of battles, approved all four of the President's nominees to the Federal Power Commission. In so doing, it forced the "voluntary" resignation of former Chairman Jerome Kuykendall from the top spot, and probably from the commission as well before his term expires. It approved a dedicated private power advocate and strong government control exponent, Joseph C. Swidler, to head the agency. It also approved a former Oregon public utilities commissioner, Howard Morgan, and a Vermont Public Service Board chairman, Charles R. Ross, to the commission.

In the only ray of sunshine, at least initially, it also approved the nomination of Lawrence J. O'Connor, an oilman and reportedly a business conservative, to a seat on the commission.

This gives the President and Chairman Swidler a clear three-man majority for the consumer-protection, tight-control concept. With Mr. O'Connor as yet a somewhat unknown quantity, and with

easiest access to regulators under-the-sidewalk



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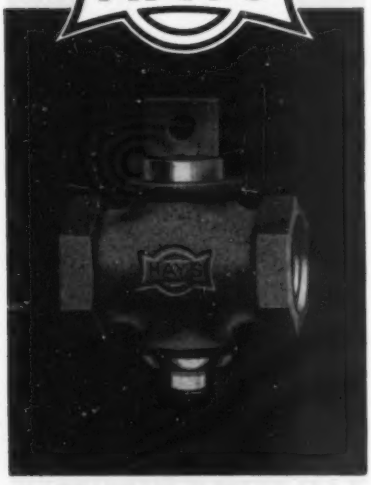

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the prospect that Kuykendall's seat will soon be open, this majority will undoubtedly climb to at least four —and perhaps five.

• *Fuels Studies*—Two fuels policy studies were formed during the congressional session. The Senate Interior Committee was directed by Senate resolution to create a special subcommittee to handle its probe. This is the only one which was specifically authorized by members. The Senate provided $25,000 to start the investigation, with more money promised next year. It will start off studying available statistics, and get into public hearings around the country next year. In the House, a Small Business subcommittee which started out to study the oil import control program has gotten into the fuels picture. It has already sent questionnaires to coal and oil firms, and will probably open public hearings within a month.

• *Legislation*—No final action on any major legislation was taken this year—but the hearings, votes, and debate on several measures, and the lack of action on others, is a clear warning. The Senate Commerce Committee held hearings on a measure drafted by the National Association of Railroad and Utilities Commissioners designed to toughen up federal natural gas regulation. It would outlaw escalation clauses, give FPC jurisdiction over industrial resales, and prevent successive rate increases. The bill was shelved for the time being.

Another measure which would have given the FPC the same power over direct sales of natural gas for industrial as it has over other sales passed the Senate, and is pending in the House Commerce Committee. Bills to cut the 27½ per cent depletion allowance were introduced and are pending.

Two natural gas bills, of the type favored by the industry, were introduced by Rep. Oren Harris (D., Ark.). The first was simply a rewrite of last year's bill. The second was a broad measure including in some form almost all of the proposals by almost anyone to the producer control problem. Both simply collected dust, and in view of the belief of FPC Chairman Swidler that legislation is not necessary for the time being anyway, aren't likely to be removed from the House Commerce Committee pigeonhole.

The gas industry also came in for its usual dose of abuse from the extreme left side of the political aisle. The sharpest lashing came from Sen. William Proxmire (D., Wis.), during the debate on O'Connor's nomination to the FPC. ■

CORROSION
Continued from page 27

man may be the top executive; there is at least one in which this is the case. Although not a technical man himself, he gets this job done by having a trusted consultant come in once a year and look the whole system over; in the interim he keeps in touch, and communicates anything which looks like it might need attention, for an occasional unscheduled visit.

The important thing is to have someone charged with the responsibility of thinking about corrosion; because corrosion does not make any noise, or attract any attention, until it is much too late. ■

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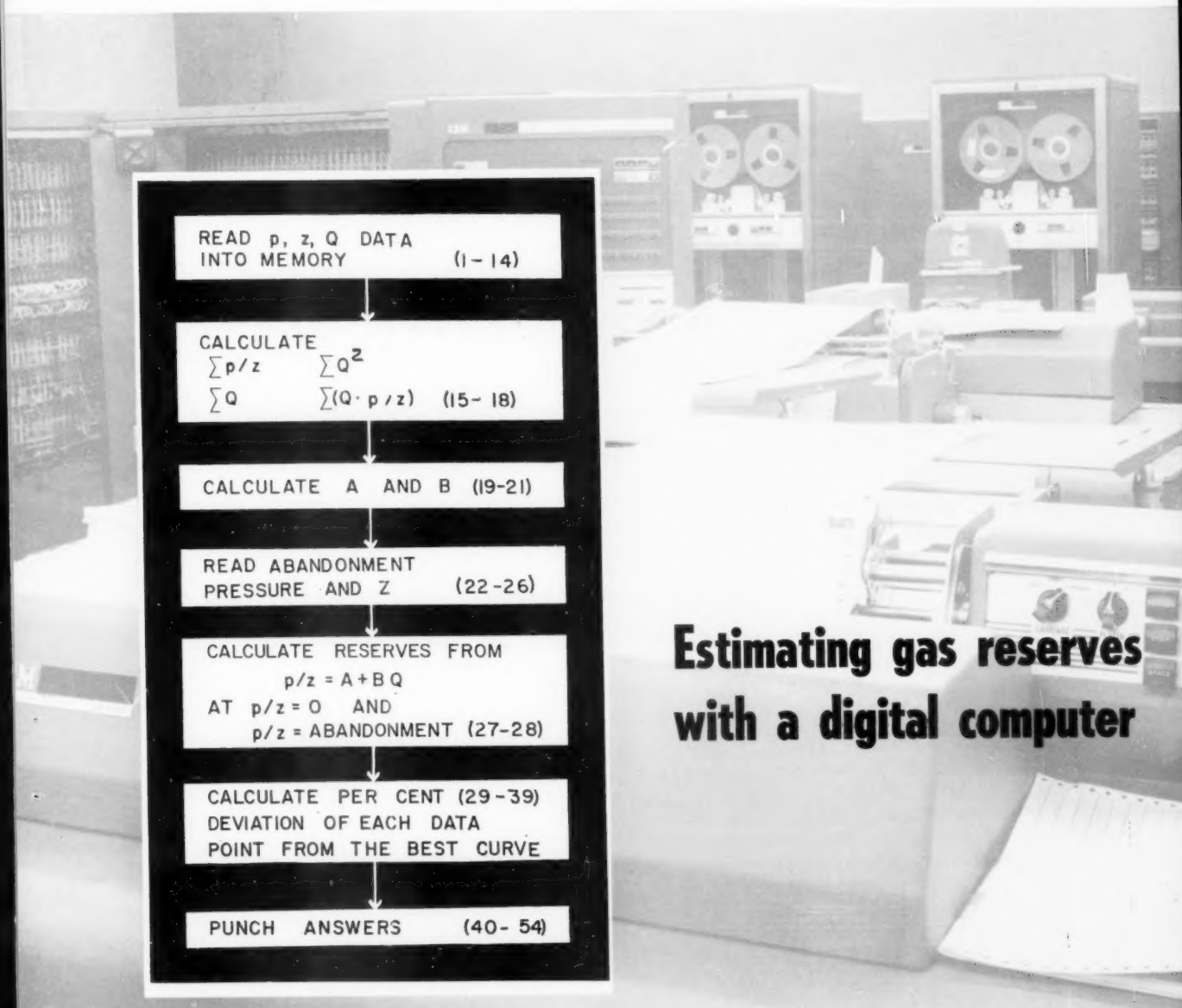
GAS

PIPELINE SECTION


READ p, z, Q DATA INTO MEMORY (1 - 14)
CALCULATE ∑p/z ∑Q² ∑Q ∑(Q·p/z) (15 - 18)
CALCULATE A AND B (19-21)
READ ABANDONMENT PRESSURE AND Z (22-26)
CALCULATE RESERVES FROM p/z = A+BQ AT p/z = 0 AND p/z = ABANDONMENT (27-28)
CALCULATE PER CENT (29-39) DEVIATION OF EACH DATA POINT FROM THE BEST CURVE
PUNCH ANSWERS (40 - 54)

Estimating gas reserves with a digital computer

NEWS FROM DOWN THE LINE!

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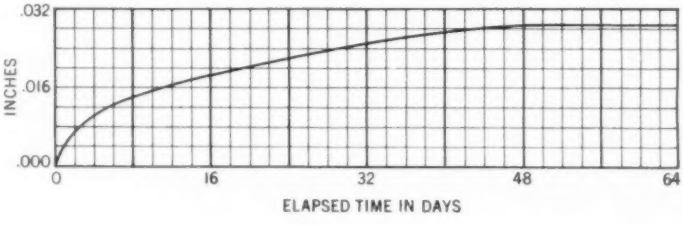
Our decision has proved sound. Breakage and excessive wear of glass fibre reinforced plastics, particularly in large sizes, has created a lack of confidence in plastics in general, but the M-2 Plastic THINsulator® has proved its stamina. Its high resistance to cold flow has been proved. Deflection test results: 1000 p.s.i. on each THINsulator runner for 64 days — total cumulative deflection only 0.029". Max. temp. during test, 105° F., min. temp., 75° F.



Its low coefficient of friction causes it to slide easily inside casing. The M-2 is completely resistant to impact fracture (4.0 ft. lbs./in. notched) and has successfully worked on 36" pipe, ½" wall, pulled in excess of 500 feet. We are convinced that it will perform as well or better than any other insulator on the market, including all known steel types. Other physical properties: *Dielectric strength* — (short time, ⅛" thickness) 500 volts per .001 inches (D149-55T); *Tensile strength* — 4400 p.s.i. at 20 in./min.; *Elongation* — 25% 20 in./min.; *Abrasion resistance* — Taber index 5.7.

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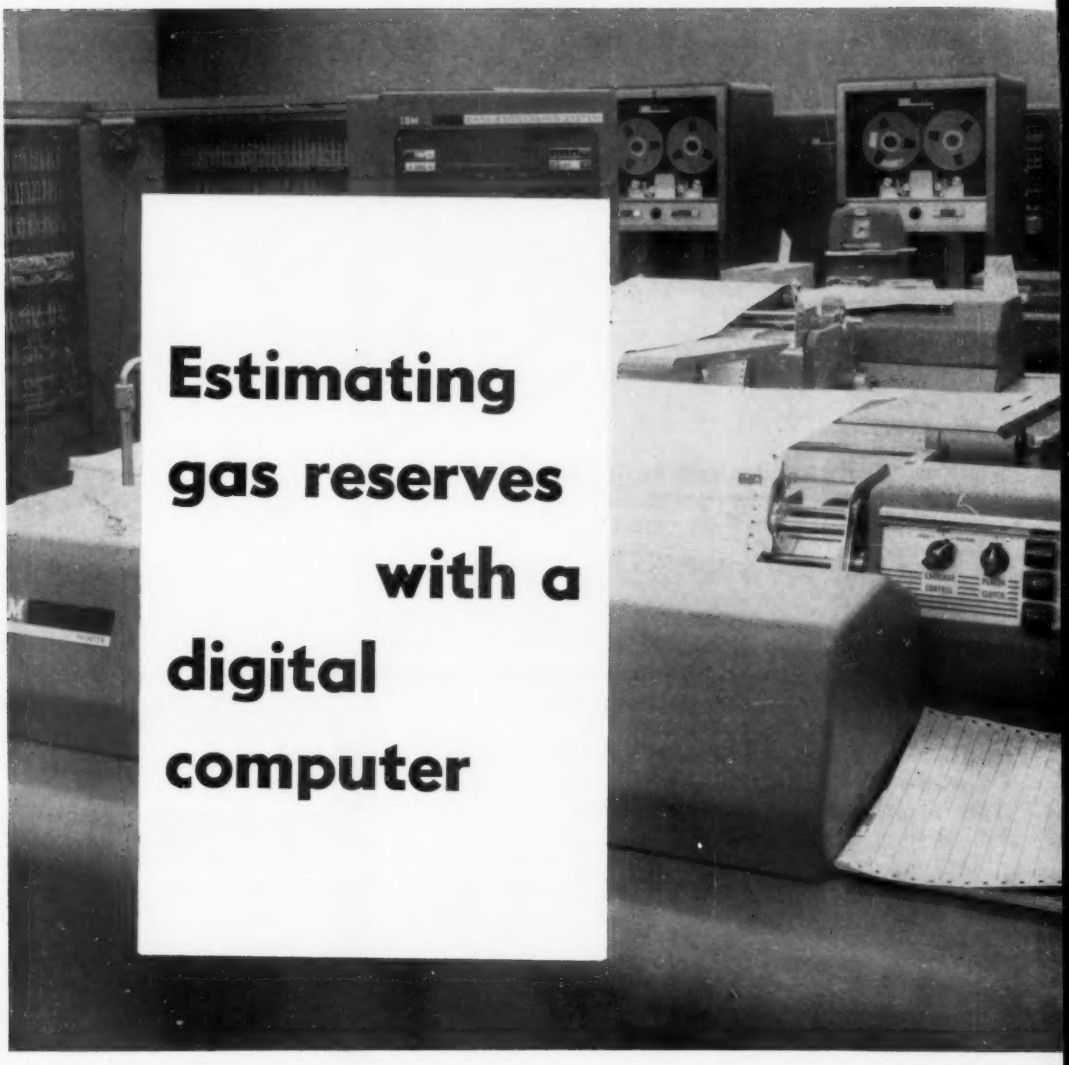

Estimating gas reserves with a digital computer

By James V. Crowley and David Cornell, Oklahoma State University, Stillwater, Okla.

THE estimation of gas reserves by the pressure-decline curve method is one of the basic tools which the natural gas industry has used for many years. Knowledge of gas reserves is an essential factor in gas contract negotiations and in securing approval for expansion of natural gas markets. The relationship of gas reserves calculations to the economic factors in gas production has been presented by Goodson.[1] McLendon[4] has discussed gas reserves calculations by the volumetric-expansion or pressure-decline method. Various aspects of computing gas reserves have been considered by Mensch.[5] Katz, et el.[3] have summarized the equations, gas properties, and other factors needed for the calculation of gas reserves.

Gas reserves can be estimated by two different methods: (1) the pressure-decline method and (2) the pore-volume method. The pressure-decline method is based on a volumetric-expansion or gas material balance calculation with no water influx and is the method considered here. The pore-volume method, which is an estimate of the pore space in the reservoir from formation thickness, acreage, porosity, and water content, is an important calculation but will not be considered.

The purpose of this article is to show a method for calculating gas reserves by means of a pressure-decline curve using a digital computer. Computer calculations have many advantages. The principal benefits are the accuracy and speed of the calculations. A further advantage in gas reserves estimation is that computer solutions are impartial. Pressure-decline curves must be fitted to field data which in-

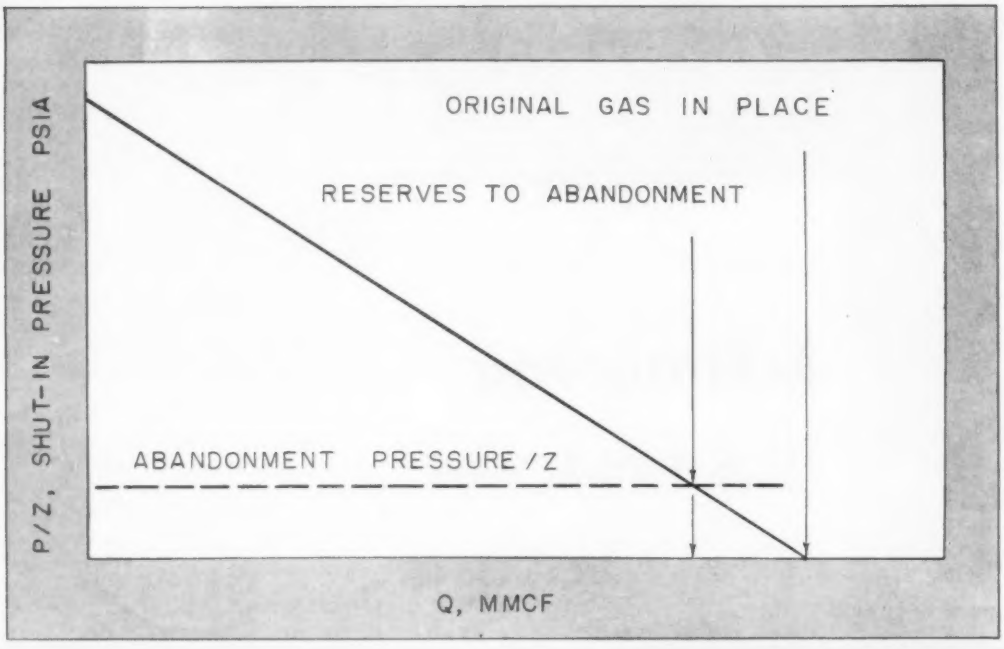

Fig. 1. Typical pressure-decline curve.

variably have a certain amount of variation. Selection of the best curve through the data points is a matter of individual judgment. Statistical methods of curve fitting can be used by the computer to provide the best, impartial, reserve calculation in every case. Of course, the computer does not have the judgment to throw out data points that are obviously in error. It is very important to inspect the results and remove any erroneous data values from the calculations, if any exist.

THEORY

The pressure-decline method of estimating gas reserves is based on the gas law, Eq. (1).

$$PV = Z\,(Q_o - Q)\,R\,T\,/0.379 \qquad (1)$$

P = shut-in reservoir pressure, psia
V = volume ft³
Z = compressibility factor
Q_o = original total MMcf of gas in the reservoir
Q = total MMcf of gas produced from the reservoir
R = gas law constant, 10.731
T = absolute reservoir temperature, °R = F + 460
0.379 = conversion factor from MMcf of gas to lb-moles of gas

Eq. (1) may be rearranged to give Eq. (2).

$$P/Z = -\frac{R\,T}{0.379\,V} \cdot Q + \frac{R\,T}{0.379\,V} \cdot Q_o \qquad (2)$$

For a constant valve of V, R, and T a plot of P/Z versus Q is a straight line as indicated by Eq. (2). This line is called the pressure-decline or pressure cumulative curve. A typical plot is shown in *Fig. 1*. It is important to note that the pressures in *Fig. 1* are shut-in pressures taken after the well has been closed in long enough to reach a true static pressure.

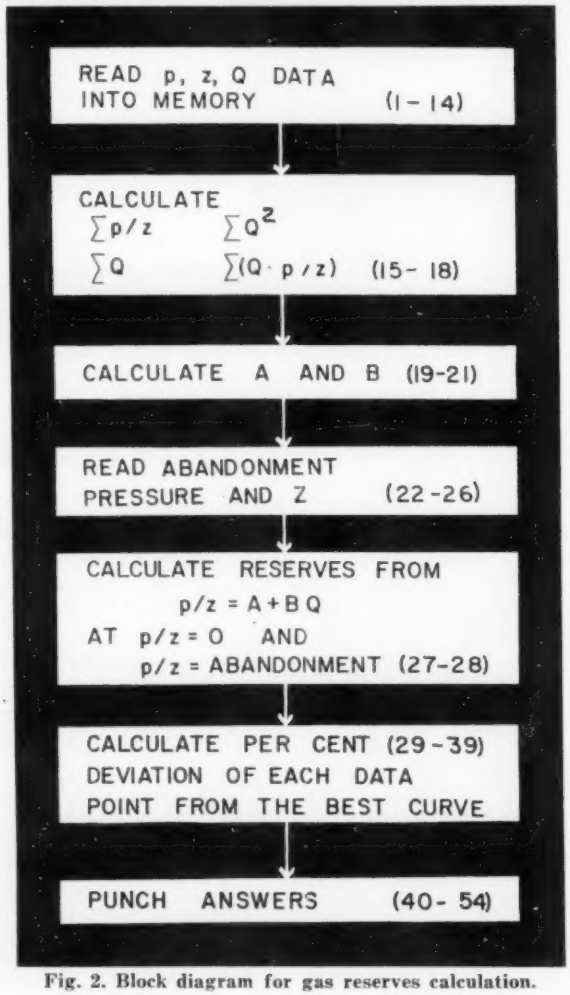
READ p, z, Q DATA INTO MEMORY (1 - 14)
CALCULATE
∑p/z ∑Q²
∑Q ∑(Q · p/z) (15 - 18)
CALCULATE A AND B (19-21)
READ ABANDONMENT PRESSURE AND Z (22-26)
CALCULATE RESERVES FROM
p/z = A + B Q
AT p/z = 0 AND
p/z = ABANDONMENT (27-28)
CALCULATE PER CENT (29-39) DEVIATION OF EACH DATA POINT FROM THE BEST CURVE
PUNCH ANSWERS (40 - 54)

Fig. 2. Block diagram for gas reserves calculation.

```
GAS        RESERVES          650          FORTRAN
    1  0  DIMENSIONP(50),Z(50),Q(50),PZC
    1  1  AL(50),PCDEV(50)
    2  0  READ,N
    3  0  SUMQ=0.0
          SUMPD=0.0
          KPUNH=0
    4  0  SUMPZ=0.0
    5  0  SUMQZ=0.0
    6  0  SUMR=0.0
    7  0  DO18I=1,N
    8  0  READ,KP,KZ,KQ
    9  0  A=KP
   10  0  P(I)=A*0.1
   11  0  A=KZ
   12  0  Z(I)=A*0.001
   13  0  A=KQ
   14  0  Q(I)=A*0.1
   15  0  SUMQ=SUMQ+Q(I)
   16  0  SUMPZ=SUMPZ+P(I)/Z(I)
   17  0  SUMQZ=SUMQZ+Q(I)*Q(I)
   18  0  SUMR=SUMR+P(I)*Q(I)/Z(I)
   19  0  AN=N
   20  0  B=(AN*SUMR-SUMQ*SUMPZ)/(AN*SUM
   20  1  QZ-SUMQ*SUMQ)
   21  0  A=(SUMPZ-B*SUMQ)/AN
   22  0  READ,KP,KZ
   23  0  AB=KP
   24  0  PABAN=AB*0.1
   25  0  AB=KZ
   26  0  ZABAN=AB*0.001
   27  0  QTOT=(-A)/B
   28  0  QABAN=(PABAN/ZABAN-A)/B
   29  0  DO32I=1,N
   30  0  PZCAL(I)=A+B*Q(I)
   31  0  PCDEV(I)=(P(I)/Z(I)-PZCAL(I))/
   31  1  PZCAL(I)
   32  0  SUMPD=SUMPD+ABSF(PCDEV(I))
   33  0  APD=SUMPD*1000.0/AN
   34  0  DO41I=1,N
   36  0  KP=P(I)*10.0
   37  0  KZ=Z(I)*1000.0
   38  0  KQ=Q(I)*10.0
   39  0  KPCD=PCDEV(I)*1000.0
   40  0  PUNCH,KP,KZ,KQ,KPCD
   41  0  CONTINUE
   42  0  KQ=QTOT*10.0
   43  0  KQABA=QABAN*10.0
   44  0  KP=PABAN*10.0
          KZ=ZABAN*1000.0
   45  0  KA=A*1000.0
   46  0  KB=B*1000.0
   47  0  KAPD=APD
          PUNCH,KPUNH
   48  0  PUNCH,KP,KZ,KQABA,KAPD
          PUNCH,KPUNH
   49  0  PUNCH,KPUNH,KPUNH,KQ
   50  0  PUNCH,KPUNH
   51  0  PUNCH,KPUNH
   52  0  PUNCH,KA,KB
   53  0  GOTO2
   54  0  END
```

TABLE 1. Gas Reserves, 650 Fortran Program

As indicated by the theory, the pressure-decline curve of *Fig. 1* is straight. The value of Q at P/Z equal to zero is the total initial gas in place. In practice, however, a gas field is abandoned at some abandonment pressure. *Fig. 1* shows the total gas that will be produced by the time the abandonment pressure is reached.

The method of least squares was used in the computer program to obtain the best straight-line, pressure-decline equation from the field data. A general straight-line equation is given by Eq. (3) where A and B are constants.

$$Y = A + BX \tag{3}$$

In the present case Y represents P/Z and X represents Q.

$$P/Z = A + BQ \tag{4}$$

For a data point that does not lie on the true line there will be a difference, called a residual, R, between the true and observed P/Z values.

$$R = A + BQ - P/Z \tag{5}$$

The best pressure-decline curve is the one in which the constants are so determined that they will make the sum of the squares of the residuals a minimum. The squares of the residuals are used in order to make all of the numbers the same sign.

$$\sum R^2 = N A^2 + 2AB \sum Q - 2A \sum (P/Z) - 2B \sum (QP/Z) + B^2 \sum Q^2 + \sum (P/Z)^2 \tag{6}$$

In Eq. (6) N is the number of data points to be used in the calculations. The minimum values of the residuals are found by setting the derivatives of the residuals with respect to A and B equal to zero.

$$\frac{\partial \Sigma R^2}{\partial A} = 0 = NA + B \sum Q - \sum (P/Z) \tag{7}$$

$$\frac{\partial \Sigma R^2}{\partial B} = 0 = A \sum Q - \sum (QP/Z) - B \sum Q^2 \tag{8}$$

The values of A and B are found from Eqs. (7) and (8).

$$A = \frac{\Sigma (P/Z) - B \Sigma Q}{N} \tag{9}$$

$$B = \frac{N \Sigma (PQ/Z) - \Sigma Q \Sigma (P/Z)}{N \Sigma Q^2 - (\Sigma Q)^2} \tag{10}$$

The computer program calculate

$$\sum Q, \sum (P/Z), \sum (QP/Z), \text{ and } \sum Q^2$$

for all of the data points and uses their values to find the best pressure-decline curve, Eq. (4).

COMPUTER PROGRAM

The pressure-decline curve calculation of gas reserves was programmed for the IBM 650 computer using the "650 FORTRAN" method. *Fig. 2* gives the block diagram for the program and *Table 1* gives the program statements. Statements (1-14) initialize certain values and permit N data points including P, Z, Q to be read from data cards. In statements

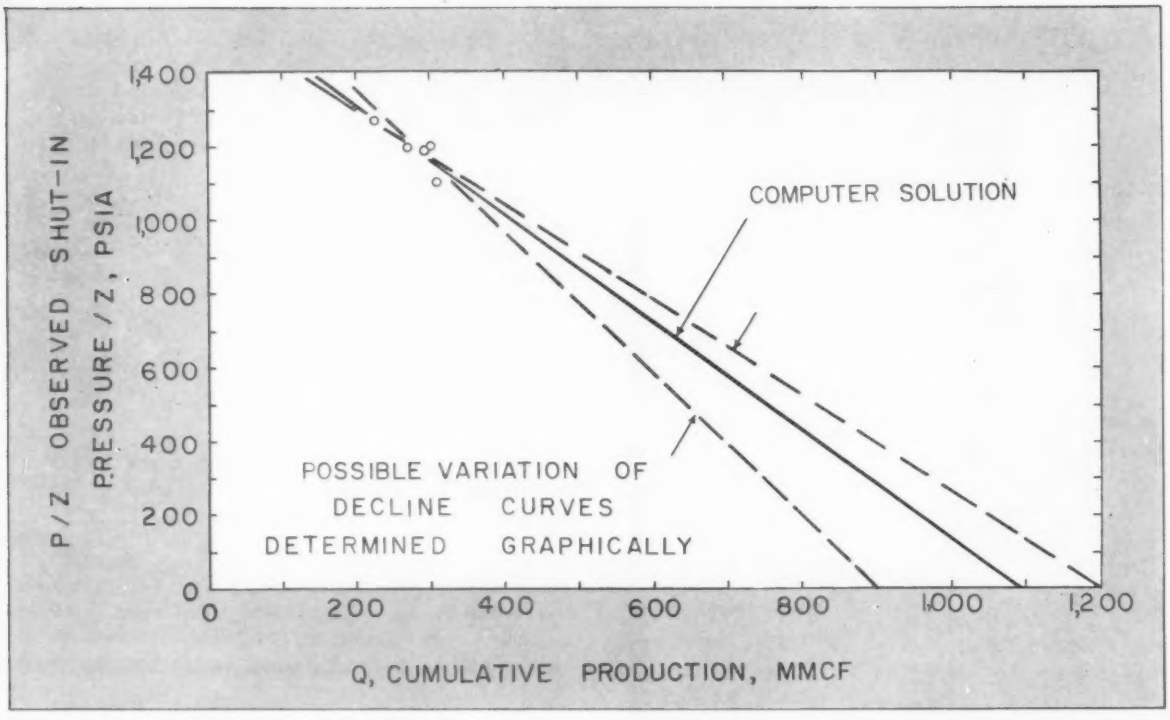

Fig. 3. Pressure decline curve for Well Y.

NOMENCLATURE

A	Dummy variable used in conversion steps in computer program
A	A constant in the straight-line equation
AN	Decimal equivalent of N
APD	Average per cent deviation
B	A constant in the straight-line equation
KP, KQ, K	Dummy variables
KPCD	Integer value of PCDEV ()
KPUN	Zero
N	Number of data
P ()	Shut-in pressure, psia
PABN	Abandonment pressure, psia
PCDEV ()	Per cent deviation from the straight line
PZCAL ()	P/Z value calculated from the straight line equation
Q ()	Cumulative production, MMcf
QABAN	Original reserves to the abandonment pressure, MMcf
Q., QTOT	Original total gas in place, MMcf
R	Gas low constant
R	Residual value
SUMPD	Sum of the per cent deviations
SUMP	Sum of the P/Z values
SUMQ	Sum of the Q values
SUMQ	Sum of the Q^2 values
SUMP	Sum of the QP/Z values
T	Absolute reservoir temperature, °Rankine
V	Volume, cubic feet
X, Y	Coordinates
Z ()	Compressibility factor
ZABAN	Compressibility factor at the abandonment pressure

(15-18) the sums required for the least squares method are computed. The constants of the decline curve equation are calculated in statements (19-21). Abandonment conditions are read into the computer on data cards in statements (22-26). Original gas in place and the original reserves to the abandonment pressure are calculated in statements (27-28). Per cent deviation of the individual data points are calculated in statements (29-39). Statements (40-54) cause the desired answers to be punched out on answer cards and the program to return to be beginning to solve a new problem.

RESERVES CALCULATION

Three sets of field data for the Douglas Reservoir in Hansford county, Texas, were obtained from F. D. Stockman of the Northern Natural Gas Co.[7] *Table 2* lists these data for three wells. For illustration purposes only, an abandonment pressure of 200 psia was specified for each well.

The data cards listed in *Table 2* were processed using the computer program. Calculations results for the three wells are given in *Table 3*. Total original gas in place, total original reserves to the abandonment pressure, and the accuracy of the calculation is shown in each case.

To illustrate the value of the computer method, *Fig. 3* shows the pressure decline plot for well Y. The computer solution gives a total original gas in place of 1097.4 MMcf. By contrast the possible pressure-decline curves that might have been drawn by hand are shown. Original gas in place by these estimates varied from 900 to 1200 MMcf. Because the computer solution is impartial and is the best mathe-

WELL X

NUMBER OF DATA POINTS

5+

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10
10812+	850+	3517+
10392+	855+	4018+
10282+	856+	4351+
10142+	857+	4852+
9922+	858+	5400+

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000
2000+	960+

WELL Y

NUMBER OF DATA POINTS

5+

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10
10802+	850+	2240+
10232+	856+	2687+
10182+	857+	2918+
10282+	856+	3004+
9542+	862+	3081+

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000
2000+	960+

WELL Z

NUMBER OF DATA POINTS

5+

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10
11442+	818+	2825+
11472+	818+	3271+
11162+	820+	3674+
11042+	821+	4087+
10922+	822+	4604+
2000+	960+	

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000
2000+	960+

TABLE 2. Data Cards

matical curve through the data points, it is regarded as being the most reliable method of reserves estimation in this case.

CONCLUSIONS

The pressure-decline method of estimating gas reserves has been programmed for the IBM 650 computer. Use of the method of least squares assures that the reserves estimate will be the most impartial and accurate value, consistent with the validity of the shut-in pressure and production data. Application of the computer program to several actual sets of field data has been made. ■

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TABLE 3. Answer Cards

WELL X

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10	PER CENT DEVIATION OF POINT X10
10812+	850+	3517+	11+
10392+	855+	4018+	11-
10282+	856+	4351+	7-
10142+	857+	4852+	1+
9922+	858+	5400+	5+

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000	RESERVES TO ABAN MMCF X10	AVERAGE PER CENT DEV X10
2000+	960+	21914+	7+

ORIGINAL GAS IN PLACE MMCF X10
25567+

INTRCEPT X1000	SLOPE X1000
1498210+	970-

WELL Y

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10	PER CENT DEVIATION OF POINT X10
10802+	850+	2240+	
10232+	856+	2687+	9-
10182+	857+	2918+	12+
10282+	856+	3004+	34+
9542+	862+	3081+	37-

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000	RESERVES TO ABAN MMCF X10	AVERAGE PER CENT DEV X10
2000+	960+	9544+	19+

ORIGINAL GAS IN PLACE MMCF X10
10974+

INTRCEPT X1000	SLOPE X1000
1598174+	1456-

WELL Z

PRESSURE PSIA X10	Z FACTOR X1000	CUMULATIV PRODUCTN MMCF X10	PER CENT DEVIATION OF POINT X10
11442+	818+	2825+	5-
11472+	818+	3271+	11+
11162+	820+	3674+	4-
11042+	821+	4087+	3-
10922+	822+	4604+	1+

ABANDONM PRESSURE PSIA X10	Z FACTOR X1000	RESERVES TO ABAN MMCF X10	AVERAGE PER CENT DEV X10
2000+	960+	29524+	5+

ORIGINAL GAS IN PLACE MMCF X10
34168+

INTRCEPT X1000	SLOPE X1000
1532856+	448-

By Ken Kridner • Engineering Editor

automation in gas industry operations

Part VII of a field study in depth

AS we arrive at this issue, I am reminded of today's citizen on the street, weary from repeated test-alerts who finally hears—"Condition Red, take cover—this is not a test." Yes, this is not a test—with this issue, we bring to a close this series on a study of automation in the gas industry of today.

We have paused to review in detail installations of both distribution and transmission companies. We have attempted to assess the value of automatic control in their operations. Naturally it has been necessary to include installations that are familiar to the reader simply because these installations have enjoyed much past publicity—it appears that everyone is interested in the unusual or the new type of installation. We do not feel remiss in looking to these same plants for our information as we feel the reader is most benefitted from their study.

We do not intend to infer that automation is the solution to all ills encountered in the handling of natural gas from the well to the burner tip. We do feel confident, however, that the management of each company is constantly striving for better and improved operations. Should the use of automatic controls satisfy this requirement, then we believe they will be used.

In studying problems related to the use of automatic control equipment we should not overlook the activities of those companies that have not installed extensive facilities of this type but yet have been investigating the problem.

EL PASO NATURAL GAS CO.

ONE of the largest gas transmission companies that does not use extensive automatic control facilities but which is actively engaged in evaluation through research and trial installations is El Paso (Texas) Natural Gas Co. This company, which delivers gas to the border of the state of California from its sources in the San Juan Basin and Permian Basin fields and through its Pacific Northwest system from Canada and the Rocky Mountain area, is one of the largest users of high horsepower gas turbine prime movers—designed for push-button operation from either local or remote control.

In discussions with Carlton C. Homan, chief engineer for El Paso, the installation of facilities utilizing automatic control equipment was reviewed. Homan is recognized in industry for his work on automation, is a member of the American Gas Association automation committee, and in 1958 was honored by the El Paso chapter of the Texas Society of Professional Engineers as its "Outstanding Engineer of the Year."

El Paso's acceptance of automated stations has been limited to the use of sequential start-stop units at three of its mainline reciprocating stations; to the remote operations of two of its electric stations and to the installation of necessary equipment for automatic sequencing control at its 12 mainline gas turbine stations.

At its Roswell and Laguna stations—each equipped with three 3400-hp Clark TLA-10 units—El Paso has used engine control panels of El Paso's design manufactured by Nelson Electric. At its Window Rock station, where nine 2500-hp Worthington SUTC units are utilized, they have gone along with a pneumatic control panel manufactured by Minneapolis-Honeywell. These installations have been designed to permit an engine to be placed on the line by one man—no effort has been made to interlock action of these engines at each station through use of a station controller.

Seligman station in Arizona—with its two 5000-hp General Electric motors driving centrifugal compressors—is designed and operating by remote control from the upstream station located at Williams, Ariz.

At 12 mainline compressor stations, El Paso has installed 32 General Electric 5000 or 5700-hp gas turbine prime movers driving centrifugal compressor units—designed to be remote controlled if desired by the addition of supervisory and telemetering equipment. However, El Paso has selected to operate these stations with personnel in attendance.

The company's efforts to determine the best procedure in application of automatic control equipment is best illustrated by viewing the establishment of committees within its organization to study optimization. For, as Homan expressed, it is his feeling that full benefit from application of automatic control equipment cannot be realized until the theory of optimiza-

tion can be proven and applied.

One of the first problems facing a company attempting to intertwine operation of its automated compressor stations is the effect of transient flow conditions in the pipeline. In an effort to resolve the transient flow condition to a language adaptable to a high speed computer, El Paso retained the services of an outside concern. A 200-mile section of its mainline system, which included two compressor stations, was selected as the basis for the problem. Actual operating conditions were compared with hypothetical computer analysis to accomplish modification of existing flow equations and to arrive at a usable transient flow equation. El Paso has been successful in reducing the transient flow condition to an equation that requires five minutes of computer time on an IBM 704. With the acquisition of an IBM 7070, it was predicted computer time for resolution of the equation would be extended and thus require further modification.

Speaking before the Winter Instrument Automation Conference of the Instrument Society of America in St. Louis, on Jan. 17-19 of this year, Homan said in part—"If this mathematical expression can be written, it becomes a tool which we can use with a computer to find the answers to our optimizing problem. If we properly construct this mathematical tool it becomes a 'mathematical pilot plant' and will give us continuous answers to our questions of 'how and why' and then we can effectively automate our pipeline system."

Homan was of the opinion that automatic control hardware is available for the operations desired.

MOVING over to Houston, we talked with the general superintendent of operations of another major transmission company. This company picks up gas throughout the Gulf Coast area and delivers it to eastern states.

The general superintendent is among the many who concur that the term "automation" is a misused phrase in the gas industry. By his definition, automation refers to the use of devices which increase the efficiency of operations and therefore improve the economy of operation.

Several years back, this firm installed automatic control equipment at a station located north of Houston. This installation was to investigate the use of remote control equipment, to determine its operations and shortcomings and to verify the company's philosophy of automatic operation. At that time the station had a single Nordberg compressor unit and adapted itself to such testing—when the station was enlarged through the addition of three more units, the remote control equipment was discontinued. The spokesman said that current-day compressor station construction projects incorporate use of sequence-starting panels, valve operators and necessary safety devices.

He continued that automatic operations in the system are aimed at maximum utilization of personnel—and it is to be expected that any automated system will minimize man-power requirements. The stations using automatic control equipment would never be completely unattended, one man would be available at all times, and the station would be attended during the daylight tower. The company currently operates its electric stations on this concept.

It has completed the design and installation of facilities at a station in Pennsylvania. Three 2000-hp Ingersoll Rand reciprocating compressor units are used in conjunction with a storage field. This station, equipped for complete self-contained automatic control, permits the dispatcher functioning from a remote point to call for a desired discharge pressure. Local station equipment operates to signal start or stop of engines, to load the cylinders and to adjust the speed of the engines. North Electric Co.'s "Paricode" system has been installed for control operation of the system. A minimum of data will be transmitted from the station to local dispatchers. The company has had little experience in the operation of this station to date.

The high load factor on the pipeline system increases the desire of company operating people to maintain continuous deliveries. Loss of station capacity through down-time on a compressor unit, though the unit has been safely taken out of service, results in lost sales. It is the company's desire to return all units to service with the least possible outage time. For this reason, it looks to availability of one man at each station on call for duty at all times. Such personnel would be skilled in the basic operations of the electrical equipment and compressor operation.

The spokesman said the company would be watching the operation of the Pennsylvania station closely for answers to the use of automatic controls at compressor stations. This station will be placed in service in the near future but at least a year of operation will be required before conclusive results can be drawn.

TENNESSEE GAS PIPE LINE CO.

HOUSTON is also home for Tennessee Gas Pipe Line Co., another of the large transporters of gas energy from the Coastal area on the Gulf of Mexico to the eastern states. Ross O. Parker, an electrical engineering graduate of Rice University and electrical engineer for Tennessee, is the coordinator of the company's program for evaluation of automatic control application. Tennessee, although watching closely the efforts of other companies to apply automatic techniques to its operations, has not to date entered into any large projects of its own utilizing automatic control equipment.

It has equipped a gas turbine station on its system with control hardware whereby the turbine may be started from a remote location. This unit, a General Electric 6270-hp gas turbine-driven centrifugal compressor, is attended in operation but controlled by a remote operator. Personnel are available on the site and may take over operation of the unit in the event communication is lost by the remote control operator.

Parker advised that Tennessee's greatest use of remote control equipment has been in the field of gas measurement. Sales meter stations are provided with coding equipment and linked to the dispatcher whereby

the dispatcher on-call may obtain data on flow conditions. Such data are then manually entered in the logs by the dispatcher.

A Solar Aircraft Co. 1000-hp skid-mounted gas turbine unit has recently been purchased by Tennessee for use at a field installation. This unit, self-contained and powering a centrifugal compressor, is used to boost gas in a field-gathering system.

ANOTHER COMPANY

ANOTHER of the large transmission companies was contacted—this a company that to date has not evidenced acceptance of automatic control through installation on its system but a company who through research has indicated a desire to determine if such philosophy is beneficial. Although desiring not to be quoted, the views of this person are of interest particularly because of his ability and forward thinking on the subject.

To this individual there are three basic ingredients that must be developed for a successful automated system—a reliable plant—a superior communication system—and a high speed optimizing computer.

Gas companies are in the business of delivering gas from the supply source to the consumption area. Every hour that a compressor unit is down represents a loss in service capacity—a loss that cannot be recouped. A company must have prime movers and compressors that can function continuously for long periods of time without shutdown or overhaul. If something should go wrong with a unit in operation, there must be someone available to detect the trouble and make a decision: (1) to keep the unit in operation by taking proper and rapid preventive action, or (2) to shut down the unit, repair the trouble and replace the unit in operation in the least possible time. It is felt the answer lies with more reliable equipment that will operate for at least a year without overhaul. This would apply to auxiliary equipment as well as prime movers.

The second phase: a high performance communication system. The prerequisite for a successful automated system is the dependability of communications —contact between the controller and the controlled. Contact with the remote facility must be maintained. The possible use of closed circuit television to perform the chores of an attendant—permitting the distant dispatcher to see the stations, the engines, to scan the various measuring devices—should be considered. For this a high degree of resolution is required—better than offered for home television use. Along with this is the associated problem of channel requirements; a channel is necessary for each television circuit.

Lastly, a high speed computer for optimizing on a continuous basis. This would permit the dispatcher to have at his finger-tips analysis of the many variables on the system—fuel cost in various localities—cost and quality of gas available for purchase—use of horsepower for the most efficient operation—evaluation of sales and purchase contract conditions—all to the end of yielding the most prudent and economic operation of the system. An optimizing computer would furnish the dispatcher a clearer picture at all times of the most economical way to operate the system.

Each of the above items is of importance in the design of the automated system and this company is progressing forward in its evaluation of the overall advantages of the automated system.

* * *

And thus we see that in every company that is in the business of transporting gas energy across this continent, the personnel in charge are striving to achieve the most efficient and economical operations. Though the method adopted may not be identical in every case, the underlying sentiment may be detected —the ever existing desire to serve the public in the most commendable method available—through the continuous and uninterrupted supply of gas at the city gate, and by the distribution company—to the burner tip in the home.

EQUIPMENT USED IN AUTOMATION

FOR lack of space, we will refrain from a detailed discussion of equipment in use by companies in their automated installations. But in passing we should like to take cognizance of a few of the items available and accepted as part and parcel of an automated facility.

Certainly the most widely accepted use of automatic control to date has been accorded the compressor station—and the compressor unit. In accomplishing this we see the seal of acceptance passed on to the engine sequence panels of Clark Bros., SIE Electronics, division of Dresser Industries, Nelson Electric, Union Switch, Cooper Bessemer, Kirkhoff and Control Corp. to mention only a few. Along with the automation of the engine unit has come the necessity for special equipment particularly in the self-contained stations. Leak detectors, sniffers that ferret out errant gas and give warning before an explosive atmosphere exists; flame detection units to detect fire; vibration sensor units to pick up evidence of malfunctioning of the engine or component parts before they result in destruction of the unit. All are necessary in the automated station and are manufactured and available from many sources.

In the prime-mover department, units that have recently entered the gas industry field are small gas turbine skid-mounted units manufactured by Solar Aircraft Co., 1000-hp and down which require little space, decreased foundation and can be operated unattended. The larger power unit manufactured by Cooper-Bessemer Corp. utilizing a 10,500-hp Pratt & Whitney jet turbine has received wide attention in

the gas industry. The 4000-hp Clark Bros. PSV unit now in use represents the entry of Clark into the large horsepower field.

There are many systems that have been successfully utilized for system control. High among these are the systems of Union Switch and Signal; SIE Electronics; North Electric Co.'s Paricode, Radio Corp. of America's "Alert"; Control Corp. 8000 Series; and American Meter Co.

Among those in the telemetering field in the measurement phase, we should not overlook Foxboro Co., Bristol Co. and American Meter Co. among others.

In the line of special equipment we would point to Computers Inc. and its pipeline simulator and compressor analyzer, both very applicable—to the mass flowmeter of Black Sivalls & Bryson—and to the fuel cells of Texas Instruments and Minnesota Mining & Manufacturing.

And finally we would look at the McIlroy Network Analyzer as a practical tool for resolving pipeline problems under steady state analysis.

Before this article is concluded, I should like to recognize the achievements of three men who in my opinion have contributed much to the status of automation in the gas industry. In paying tribute to these men, I do not wish to belittle the important part played by other leaders in the industry and whose efforts also have been necessary for the progress achieved to date.

Standing foremost in the group of technical persons striving to resolve problems encountered in automated operations is a vice president for Columbia Gulf Transmission Corp., Sy Orlofsky. We would pay special acknowledgment to the contribution given by Orlofsky because he "fathered and nurtured" the first remote controlled mainline compressor station — at Stanton, Ky. For his perseverance and unswerving belief in the philosophy of automatic control, Sy has earned the respect of industry and is recognized as a qualified authority on the subject. That he is intensely interested in the future of the gas industry may be seen from the test-installation of the Cooper-Bessemer jet turbine and the large Clark Bros. PSV compressor units on Columbia Gulf's system. Our hat is off to Sy, a leader of men into the future.

Promoting a philosophy of operations differing in component requirements is a man relatively new in the ranks of the gas industry but who has in a short time demonstrated his ability in the field—Neal B. LauBach, vice president of operations for Colorado Interstate Gas Co. LauBach became associated with CIG in late 1958 and in the short time since his affiliation with CIG has been instrumental in the program adopted by Interstate for automation of its compressor station facilities. LauBach is an advocate of the self-contained station and is well-known for talks he has given on the subject of automation. He is chairman of AGA's automation committee established to study the advantages to be gained from use of automatic controls. For his progressive leadership, we salute Neal LauBach.

In the distribution field, we would recognize the activities of the leader of one of the most forward seeking companies of natural gas—Marvin Chandler, president of Northern Illinois Gas Co. Chandler has long been accepted for his progressive thinking in the operations of the company he heads—the system described earlier in this series pointing out the utilization of a high speed computer speaks out for Chandler's thinking on this subject. The first use of a fuel cell on a company system was by NI-Gas in its cathodic protection program. Customers of this very aggressive company can look to the leadership of Chandler as assurance that their service will continue to rank second to none. To Marvin Chandler, we would pay tribute for a job well done.

In conclusion, let us look briefly at where automation stands in the field of industry today—

1. Immediate needs are for high speed communication equipment comparable to speeds of electronic computing gear, for resolution of the transient flow condition to practical application, for development of a commercially priced measuring device that will emit a single signal of flow condition and for a low cost power source for field installation.

2. Manufacturers of new equipment must *sell* their products to gas companies; recognizing that the gas industry is a regulated and controlled industry, the manufacturer must be willing to *invest in trial installations* to prove his equipment.

3. Acceptance of automation in the gas industry depends upon the imagination, incentive and drive of industry and manufacturing people for development and application of the proper and necessary equipment.

4. Automation will be accepted in the gas industry only if it is engineering sound and economically feasible. An automated facility based on glory alone will not long endure the test of time as a statue to automation. (This point cannot be overemphasized.)

5. Automation has received the tacit approval of most gas companies and is now in the process of acceptance and adoption through performance.

In acknowledgment, I wish to express my appreciation to all readers. This series which began in April has wandered afield through the activities of distribution and transmission companies in these United States, discussing operations of those companies that exemplified the philosophy of automation. To those companies who cooperated in making this series possible I extend my appreciation. If there should be some I have failed to include, my deepest apologies. To those persons who attended the Seminar sponsored by *GAS* in New York City on St. Patrick's Day at which I discussed the subject matter of this series, my sincerest hope that the information presented conforms. To all—thanks. ■

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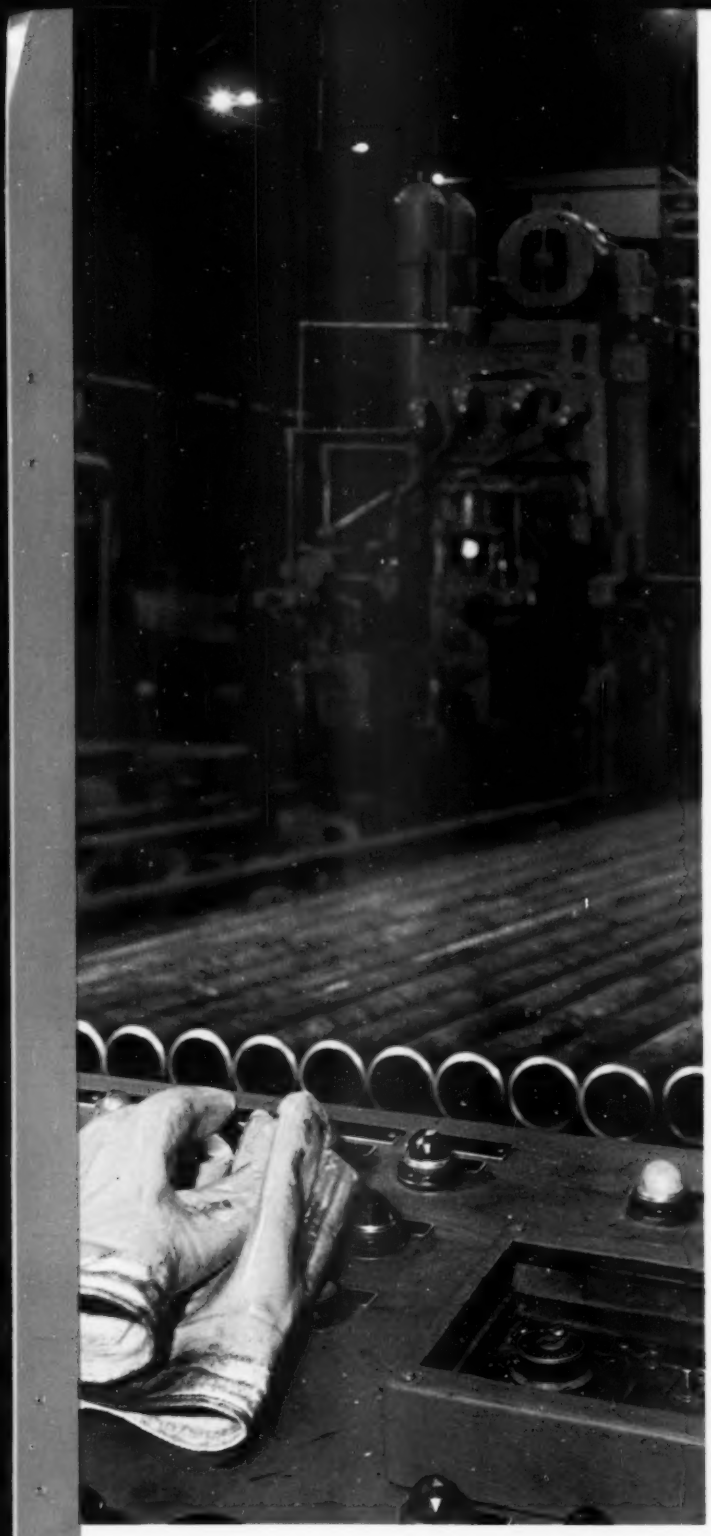

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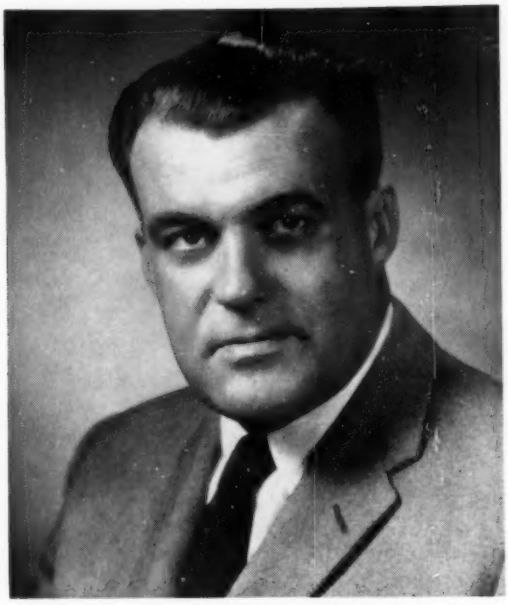


Texas Gas Transmission Corp.'s W. M. Elmer heads Independent Natural Gas Association of America for the coming year.

SPEAKING before members of the Independent Natural Gas Association of America in Houston, retiring president W. E. Mueller emphasized a change in the atmosphere in which today's gas industry operates will "come only as you convince the public by word and deed that what we say is true. It means making our little-known business well understood. It means sharing the burden of telling our story to consumers, to Congress, to states and to the leaders in our communities far better than it has been told before." Mueller's comments set the tenure for the meeting held Sept. 18-19 at the Shamrock Hilton hotel where 500 representatives of distributing, pipeline and producing segments of the natural gas industry heard industry and government speakers talk on the merits of area-pricing, industry-government responsibility and resumes of industry progress.

Outgoing president W. E. Mueller calls for "making our little-known business well understood."

In his annual report before the membership, President Mueller stressed the increasing complications in regulatory control of the gas industry—permitting a state utility commission in the Atlantic Seaboard to intervene in a proceeding concerning gas from California. A greater understanding of the problems of the gas industry by the public and its elected representatives can result in great benefits for the public interest and for the defense of the nation, Mueller said. Pointing to the growth of the industry, he predicted a public demand for gas in 1970 nearly 75 per cent greater than today, or 18.5 trillion cu ft annually versus 13 trillion cu ft consumed in 1960.

W. M. Elmer, president of Texas Gas Transmission Corp., Owensboro, Ky., was elected to head the INGAA membership through its 1961-62 activities. Elmer, who graduates to the presidency of the large national association from the post of first vice president, succeeds Mueller, president of Colorado Interstate Gas Co. of Colorado Springs. Other officers elected for the new year were Orville S. Carpenter of Houston, first vice president, and George P. Garver of Chicago, second vice president. Carpenter is president of Texas Eastern Transmission Corp. and Garver is president of Natural Gas Pipeline Co. of America.

Three new directors named were Mills Cox, Trans-

By Ken Kridner • Engineering Editor

western Pipeline Co.; W. K. Sanders, Trunkline Gas Co., and W. J. Bowen of Houston Corp.

CONVENTION HIGHLIGHT

Highlight of the two-day session was the first major policy speech delivered by the Hon. Joseph C. Swidler since his appointment as chairman of the Federal Power Commission on Sept. 1. Leaders of the gas industry who looked to Chairman Swidler's speech for an indication of policies to be followed by the Democratic Commission were not disappointed. The new chairman of the regulatory agency came out strongly on behalf of area-pricing as being "far preferable for producer and consumer alike."

Swidler drew attention to his TVA background twice during his talk and pointed up the difficulty any person might expect in fulfilling a task in the federal agency. "If, by any chance, the regulators should satisfy both seller and purchaser, then undoubtedly there would be third parties to say that the wrong method was used, and that the result was illegal," he said.

Although stressing that opinions expressed were his own, Swidler took cognizance of risks involved in a production company's quest for supply and indicated his support for a fair return. "We cannot expect him to continue risking his money . . . without offering hope of something more than a return on the money expended at the level which is usual for the largely risk-free investments. . . ."

Chairman Swidler drew his strongest applause when he referred to his hope that parties will grow more confident of the agency's decisions and be more inclined to abide by its decisions. But he added, "Being realistic, I will say that I do not expect a decline in natural gas litigation of such magnitude as to decimate the bar." He added that he hoped commission decisions in the future would be expressed in such clear-cut and comprehensive language that there would be no doubt as to the basis for their decisions.

Swidler was appointed to the commission in June by President Kennedy and ascended to its chairmanship in September. Other members of the commission on hand for the meeting and on the rostrum with Chairman Swidler were Democrat Larry O'Connor and Republican Jerome Kuykendall, former chairman of the commission.

In coming out strongly for area-pricing, Swidler stressed his feeling that production of natural gas does not lend itself to an individual well or even company-by-company cost-of-service and rate-of-return approach. It is a necessary ingredient that price for product and service performed must be related to costs. "The Natural Gas Act, the courts, the consumers, and from the indications in your pleadings, you, yourselves, cannot be satisfied with regulated prices which are not somehow related to costs," Swidler told his listeners.

The lone note of foreboding in Swidler's speech came near the end of his delivery when the commissioner referred to the gas industry as being fascinating and perplexing, full of puzzles and paradoxes. Then he added, "The greatest of these paradoxes seems to me to be that in this, the fifth largest industry in the nation, accounting for about one-third of all of the energy consumed in the nation and serving over 34 million consumers, there is no unified responsibility for supplying the requirements of the consumers. The distribution company, when it needs greater supplies, must depend upon the reserves of producers with which it does not even have direct contractual relations and who are joined with it only through the pipeline company intermediary.

FDC Chairman Swidler: "If . . . regulators should satisfy both seller and purchaser, then undoubtedly there would be third parties to say that the wrong method was used, and that the result was illegal."

"My background in the electric utility field, where integrated operations are the rule, makes me wonder how a system with no unified responsibility could operate efficiently." Swidler continued to say that his newness to the problems of the industry apparently indicated more to the system than met the eye.

Swidler's talk was warmly applauded by the members of the INGAA organization upon its completion.

GOVERNMENT CIRCLES

Sharing speaking honors from government circles was James K. Carr, Under-Secretary of the Interior. Carr brought out that competition between fuels has been a stimulus for technological advance and has been a major force in shaping our economy. Referring to his past association with an electric power distribution system, he said that he knew at first hand that when energy sources are in competition you really get the cost down.

"In light of our past experience," Carr stated, "I suggest we think long and hard as a nation before we start dulling the cutting edge of competition among the sources of energy."

The Under-Secretary recognized the efforts in behalf of industry leaders to assist in the defense program of the nation. He pointed to the fact that pipelines are underground and thus less vulnerable to enemy attack as an indication of the importance of gas in time of a national emergency. At this time the gas industry has furnished 31 specialists for the

Executive Reserve—a standby emergency organization.

During the first week of October, the Department of Interior conducted a course of training in radiological monitoring in St. Louis, Mo. Carr stated that this course was primarily for training of industry instructors who would then take the material to other personnel in the industry.

The subject of helium was given considerable importance by Under-Secretary Carr as he stressed the loss of over 4 billion cu ft annually, more than 10 times present helium consumption. The department has recently completed two contracts for helium recovery but has been authorized to spend up to $47 million—and is seeking to complete contracts with other companies. Carr requested those companies that had previously applied renew their proposals.

FINANCIAL VIEWPOINT

Looking at the picture from the financial viewpoint, Gene M. Woodfin, partner in the firm of Carl M. Loeb, Rhodes & Co., drew bead on regulatory chaos and a hostile climate in the Congress and courts for his persuasive picture of the uncertainty surrounding the investor when considering offerings of the gas industry. Woodfin drew range on the Natural Gas Act as the culprit for the unhealthy atmosphere attributed to the gas industry by most financial institutions.

"As you can gather from my comments," Woodfin stated, "we no longer consider the gas industry, by and large, to be a vehicle for acquiring capital gains nor one for realization of appreciation comparable to that of the Gross National Product."

He pointed to statistics of the electric utility industry, weak in 1945 earning about 8.5 per cent on common equity as measured by FPC Class A and B, compared to the gas companies that could bring down from 12 to 14 per cent or more on common equity. Electric utility companies today earn 12 to 13 per cent on a much thicker common equity while commission courts have stated that a figure lower than the previous earnings is adequate for the gas companies.

Woodfin referred to the beguiling statistics on gas reserves. Though current reserves are arithmetically adequate for a 20-year gas supply at the present rates of withdrawal, this does not take into consideration the fact that the deliverability of these reserves is not a 20-year deliverability. But perhaps a 30-year or 40-year deliverability. Thus, what appears to be a 20-year supply at present rates of withdrawal is actually a much shorter supply if rates of withdrawal increase as predicted. He stated that most transmission companies have ample current supplies but their full deliverability in most cases does not extend more than 10 to 12 years.

Woodfin suggested that the area-pricing procedure would give the producer assurance of what he would receive from his gas. While critical of the way in which regulatory bodies were handling rate cases, wherein "each person is free to present his economic theory from a standpoint of what serves his interest best," he felt the Natural Gas Act represented the basic fault in failing to furnish guide lines and standards.

"The commission's greatest and most lasting problem will be if through shortsighted policies it creates an artificial shortage of the supply of gas," he said.

Woodfin offered six suggestions that might be followed by the Federal Power Commission. (1) Ritualistic formulas should be re-examined. (2) Clear-cut policy lines should be adopted. (3) Prompt settlement of pending rate matters should be encouraged. (4) Commission staff should view all things from standpoint of all parties. (5) FPC should recapture control from courts and intervenors. (6) The commission should immediately formulate a workable statute to interest of all.

Chairman Swidler in his press conference following his speech stated that the commission had no obligation to protect the stockholders in the gas industry by making a glamor-issue of gas securities.

Other speakers at the INGAA conference were Dr. Martin A. Elliott, academic vice president of the Illinois Institute of Technology, who spoke on the subject of "New Uses of Gas Through Research." Dr. Elliott in referring to $3 million allocated for AGA research projects this year and expected to increase to $6 million in 1965, stated that there are many advantages to be gained from cooperative research.

Ability to finance large projects, elimination of duplication of effort, and pooling of information and experience of all companies were named as principal advantages.

Currently under development at the institute is a fuel cell that could be used in conjunction with batteries to supply all of the electricity requirements for the average home. Another project of interest is the technique of storing liquefied natural gas at atmospheric pressure in subsurface prestressed concrete

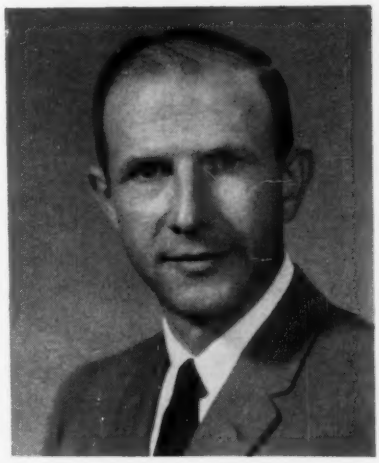
Under-Secretary Carr: ". . . I suggest we think long and hard as a nation before we start dulling the cutting edge of competition among the sources of energy."

Lawrence H. Gall has been named executive director of the Independent Natural Gas Association of America, headquartering in Washington.

Gall has been acting executive director since May. He succeeds John A. Ferguson, who retired and is currently serving as a consultant to the board of directors.

With the gas industry since 1946, Gall has been director of research and counsel of INGAA since 1953. In the last few years he has served as general counsel. Prior to that time, he was a partner in the law firm of Disney and Gall, which served as counsel for INGAA.

Gall is a graduate of the University of South Carolina. He is a member of the Federal Power Bar Association, the District of Columbia Bar Association, and the American Bar Association.



structures. This storage technique promises to yield substantial savings over aboveground storage.

COMMITTEE MEETINGS

Addressing opening committee meetings Monday morning, Oliver L. Stone, general attorney for Shell Oil Co. appeared before the producers division and James A. Clark, GAS columnist and a syndicated columnist of the "The Houston Post," talked to the public relations committee.

Stone reviewed recent developments before the Federal Power Commission, the courts, and in Congress. His discussion of each decision brought out conflicting policies that have appeared in recent rulings.

Mentioned was the ruling in August on Docket G-18338 involving Coastal Transmission et al. Chairman Kuykendall, at that time head of the commission, and Commissioners Kline, Swidler (now chairman) and Morgan participated in issuance of the Coastal order. By this order the commission issued certificates with open-end price refund conditions to 53 producers for sales in both Texas and Louisiana and approved applications of Coastal and Houston Texas Gas and Oil Corp. to expand natural gas service to Florida.

One of the unique features of the Coastal order was that the commission issued permanent certificates without making a finding as to what price is in the public convenience and necessity, leaving that aspect for determination in some future proceeding of some kind. In the meantime, the producer if he accepts the certificate, obligates himself to refund the difference between his contract price and the price which the commission will ultimately determine to be in the public convenience and necessity. "Just when that determination will be made is uncertain," said Attorney Stone. He continued, "How, I would like to ask, can the producer determine on what basis and under what conditions he should pay royalty and taxes if he accepts such an open-ended certificate and delivers gas thereunder?"

Stone stated that from seven years' observance of the gas industry, he was convinced that the Natural Gas Act must be amended in light of the producer problem.

He suggested that FPC hold a single nation-wide, industry-wide hearing to determine the industry's financial requirements followed by several conferences to fix rates for specific areas.

Jim Clark who is well-known in the oil and gas industry for his many timely articles on industry operations, said that all segments of the industry must recognize their common problem and attempt to understand the problems of each other better. Looking to the regulatory bodies, Clark stated that they should also strive for a better understanding of producers, transmission lines and distributors and vice versa.

"How the courts can arrive at decisions in gas cases in an intelligent and digestible form, with the meager data available to them, is beyond comprehension," he continued.

Clark looked to an organization that would have the public interest as its prime goal and which would attempt to bring about a closer understanding between all segments of the industry. Such an organization with such quest would be a worthwhile project.

After two days of meetings, the industry leaders attending the annual session of INGAA considered statements made by government and industry personnel and formulated a resolution which met approval of the group.

This resolution considered regulation of producers' field prices, recent Federal Power Commission actions, and the necessity for a regulatory and legislative climate sympathetic to the gas industry and was stated as follows:

Be it resolved: That the association and each of its members reaffirm its position of making every effort to obtain a fair and reasonable legislative and regulatory climate for all segments of the natural gas industry. ■

Proving-out the mass flowmeter

Fig. 1. The mass flowmeter.

By Ken Kridner
Engineering Editor

SOME months back, the personnel of Black, Sivalls & Bryson Inc. and General Electric announced the successful design and manufacture of their mass flowmeter. This instrument measures true mass flow and gives a record of weight of gas passed. Their design and philosophy advocated determination of a single variable to measure gas passing in preference to previous efforts of others to determine separate variables to arrive at the same place. BS&B has been designated distributor of the mass meter in the oil and gas industries.

Having successfully completed the first part of the task—that is, availability—it became necessary to develop a proving device whereby leaders of industry might have assurance the unit mass measured reflected the mass passed. The equipment designed for proving the mass meter is unique in its simplicity yet adequacy. The prover is located at BS&B's research laboratory in Oklahoma City.

In late 1952, BS&B personnel were attracted to the study of mass flow prompted by interest signified by a large oil and gas company. There followed a year of intensive study of the problem utilizing the facilities of Midwest Research Institute of Kansas City. Efforts of General Electric in the field of government research came to BS&B's attention in the fall of 1953 and negotiations began between the two companies—culminating in a joint effort by the two. Result of this association is the mass flowmeter manufactured by General Electric in its West Lynn, Mass., plant and distributed in the oil and gas industries by BS&B.

Weighing only 105 lb and measuring less than 14 in. in length, the mass flowmeter is clean-cut and compact. (*Fig. 1* shows the instrument as it appears.) Electrical power must be available to the installation site for operation of the instrument.

Installation problems are insignificant otherwise. The meter is sold with a set of 4-in. flanges either eccentric or concentric, and may be installed in any size pipeline necessitating only swaging to the inlet flanges.

The flowmeter must be mounted in a horizontal run of pipe and attention should be given to the configuration of pipe and valves upstream of the instrument. The instrument must be installed level within 3 deg. of both horizontal axes (longitudinal and transverse).

Construction of the meter itself consists of two turbine wheels mounted on a common axis—the upstream wheel, known as the impeller (*Fig. 2*) is magnetically coupled to a synchronous motor mounted outside the flow stream. This permits the equipment used in conjunction with the mass flowmeter mounted outside the flow stream to be operated at atmospheric pressure. The instrument meets explosion-proof requirements for use in Class 1, Group C and D locations as classified by the National Board of Fire Underwriters.

Mounted on the periphery of this turbine wheel are small guide vanes designed particularly for this application. Incoming gas encounters the impeller rotating at a constant angular velocity. The majority of the gas stream passes through the guide vanes and the angular momentum of the constant velocity impeller wheel is imparted to the passing gas. As the gas emerges at the downstream tip of the guide vane of

the impeller wheel, it is moving with an angular momentum matching that of the impeller. Mounted downstream of the impeller yet independent of it is the turbine wheel. This turbine wheel has been mounted stationary in the flow stream and on low friction bearings whereby any force that tends to move it is transferred as a torque to the shaft on which it is mounted. The guide vanes on the turbine wheel are identical to those on the impeller but will serve to remove angular momentum imparted by the impeller wheel. As the gas leaves the impeller with an angular motion and enters the vanes of the stationary turbine, the angular momentum will be removed and the gas stream straightened. The momentum absorbed in the removal of the angular force will be applied to the axis of the turbine wheel as a torque.

By using a device for measuring this torque and transferring the measurement by means of a magnetic coupling and linkages, the force required to remove the impressed angular velocity is impressed on a gyro-integrator. This integrator constitutes a breakthrough for General Electric and BS&B and is novel to the gas industry. The torque measurement is applied to the minor axis of the gyro-integrator (see *Fig. 2*) and the movement of the major axis is geared to a register that records in unit weight the amount of gas passed. This record could be maintained in any unit of weight desired but for convenience in the gas industry has been provided to yield pounds per hour.

Basis for the mass flowmeter is derived from fundamental laws of dynamics resolved into the equation $T = wK^2 (dm/dt)$. In effect, this equation states that if the angular velocity is constant (w) and other geometrical constants (K) remain unchanged, then the mass flow (dm/dt) can be determined as a direct function of torque on the turbine (T). This is a simplified statement of a complex equation and the reader may obtain complete derivation by contacting Dr. E. G. Young at BS&B's Oklahoma City plant.

THUS WE COME TO PROVING

To the measurement man the existence of a mass flowmeter, though desirable, does not of itself resolve the existing problem of gas measurement in the field. For many of the field personnel through long years of exposure and application have become wedded to the necessity for proving accuracy of gas measurement by verification of the differential manometer—normally accomplished by use of a water manometer. It became a prerequisite to the acceptance of the mass flowmeter that a unit be designed whereby the proof of the flowmeter could be visually demonstrated as well as theoretically explained. Thus fell to the lot of Dr. Young and his staff the design and construction of a prover for the mass unit. There is a staff of over 20 engineers and technicians equipped with all necessary facilities for fabrication of desired testing and proving equipment. Dr. Young obtained his BS degree in

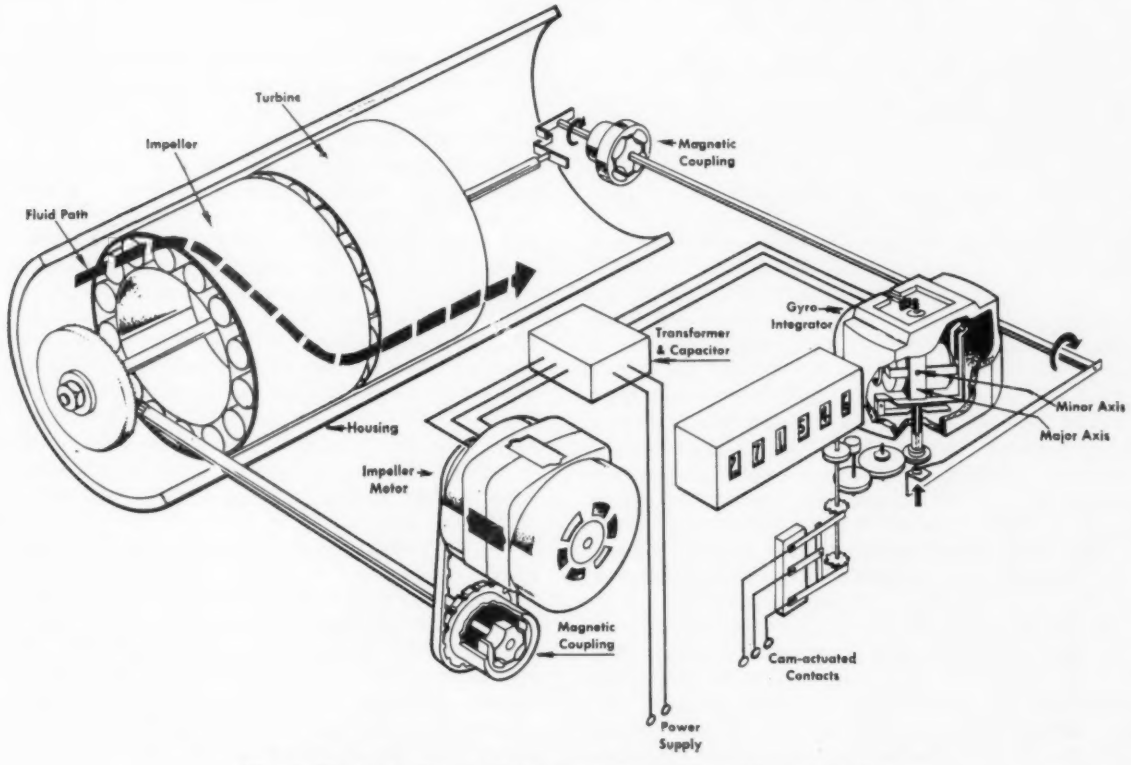
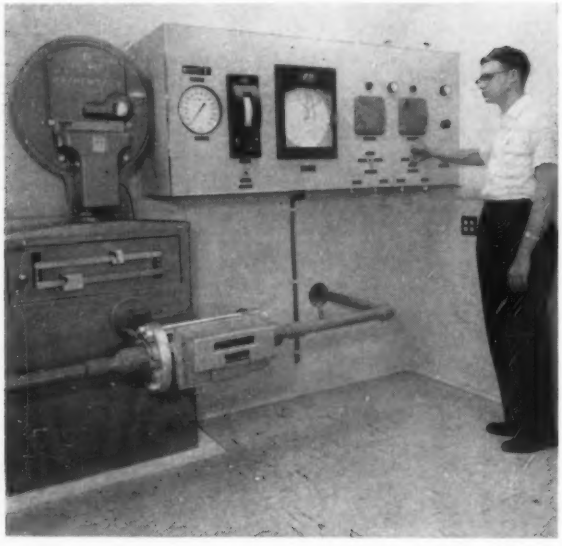


Fig. 2. The basic theory of the mass flowmeter and how it works.

Fig. 3. The prover control room.



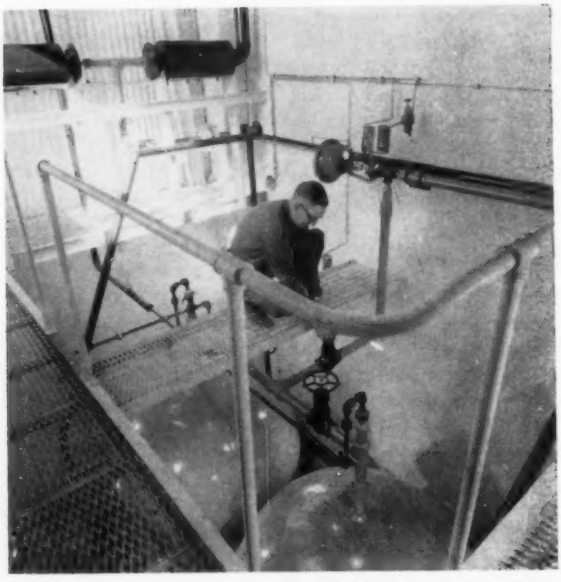


Fig. 4. Partial view of prover showing control exhaust orifices (upper left), regulator and tanks.

Mechanical Engineering from Yale and his Doctorate from the University of Texas.

The problem resolved into determining unit mass passing through the instrument during a unit time whereby a direct comparison could be made for calibration. Dr. Young's staff selected a procedure unique in its simplicity. They weighed the amount of air passed during a unit time on a commercial scale and at the same time measured the exhausted air through the mass flowmeter; by comparing weight loss in the closed system as shown by the scale with the unit mass (weight) passed on the meter, a direct correlation results.

This was accomplished by use of two large high pressure spherical tanks hydrostatically tested to 4500 psig to hold the air medium for test. Pressure control valves were used to maintain a constant downstream pressure and the unit to be tested was installed downstream of the control valves. The air was exhausted through critical flow nozzles mounted in opposite horizontal directions. Mounting the nozzles in this fashion permits canceling of any forces that might be set up by the discharge velocity of the air stream. All testing equipment, piping and valving was mounted on a commercial scale in such a way that after the tanks were filled and the connecting piping removed, the entire system was supported on the scale mechanism. (See *Figs. 3 and 4* for the test apparatus.) The tare weight of the tanks, meter unit and piping exceeds 7000 lb. Accuracy of the scale is within 0.5 per cent over a range of 2000 lb and to within 0.25 per cent over a range of 500 lb. Normal test run on the unit utilizes only 250 lb of gas.

Before a test run is started, the system is connected to an external source and the tanks pressured to near 3000 psig—at this pressure air in the tanks will weigh about 1600 lb at 90 deg. F. The external source is then disconnected, the meter installed and the entire system placed in balance on the scale.

At this point, we should take into consideration one facet of the operation of the gyro-integrator mechanism on the mass meter. Each rotation of the gyroscope has a definite relationship to the register resulting from the direct gearing of the two units. A small reflective surface is mounted on the axis of the gyroscope that will trigger a camera to photographically record the scale reading for each revolution of the gyroscope.

Proper critical flow nozzles are installed before testing commences. Pressure control valves are regulated for the proper downstream pressure. The system is then opened and air passed through the meter and exhausted to atmosphere, and the decrease in system weight recorded for each rotation of the gyroscope.

After the test run has been completed and compared with the two readings, adjustments for span and zero can be performed by technicians. There are

three adjustments on the instrument; two for zero adjust and one for span.

In addition to testing by use of the prover assembly, BS&B also has a "flow loop" whereby it can test four meters simultaneously against a master meter. This permits proving of the master meter by the more time-consuming prover test—then verifying accuracy of other units on the flow loop. In this operation a constant volume blower is used to maintain a continuous movement of air through the loop.

A field procedure for testing the unit to verify the accuracy of the gyro-integrator has been developed and consists of impressing a known torque on the discharge turbine sensing device—the gyro should then result in a known register reading change. This may be considered testing of the secondary measuring device and corresponds to the verification of the accuracy of the orifice meter by use of a water manometer. Testing of the instrument by the prover or flow loop verifies the basic measuring device of which there is no counterpart in the gas industry for true mass flow.

Of significant interest to the gas industry is the fact that a meter was calibrated after having been in service for 18 months and no deviation from the original calibration curve was found.

MASS METER DELINEATIONS

The mass flowmeter is specified by mass flow and density of the fluid passing. Since variables of gravity, temperature, pressure and compressibility are not functions of mass flow in the use of BS&B's mass flowmeter, it is not necessary to take these items into consideration except for determination of mass flow rate and density for selection of the proper range instrument.

Calculation of base density is performed by adding the reciprocals of the minimum and maximum density, dividing by two, and then taking the reciprocal of the answer. For example, if the density range is from 2 to 6, then:

$1/2 + 1/6 = 0.5 + 0.17$
equals: 0.67
then: $0.67/2 = 0.34$
and: $1/0.34 =$
Base density of 2.94.

The importance of this base density is recognized in the guarantee of the instrument. An accuracy of plus or minus 1 per cent of point reading is guaranteed for all measurements falling within 30 to 133 per cent of rated flow at base density. For other densities in the design range and for the same flow limits, the guaranteed accuracy is 1.5 per cent. Accuracy of the instrument falls off below 30 per cent of rated flow and under 10 per cent of rated flow use of the meter is not relied upon.

The mass flowmeter is adaptable to automation projects. Pickoff of the pulse emission for each rotation of the gyroscope may be amplified and the signal used for activating control valves, for telemetering, for tape printers and other devices relying upon an electric signal for triggering.

BS&B's association with General Electric and its designation as the distributor for the mass flowmeter in the oil and gas industries is indicative of the high respect held for this aggressive concern.

BS&B—THE COMPANY

BS&B is well known in the oil and gas industries for precision and dependable equipment. The company began 68 years ago in Ohio as an association of the two Black brothers and Jim Sivalls. As the oil industry moved west, the company followed and W. G. Bryson joined the group at Bartlesville—the firm incorporated under the laws of the State of Maine. In 1926, the company acquired American Tank Co. In 1946, Black, Sivalls & Bryson was incorporated under the laws of Delaware with ownership changing from a family controlled business to that of a broad group of investors. Through the intervening years, BS&B has added Control division of Climax Engineering Co., Zenite Metal Corp., and United Engineers Inc.

There are over 2500 employees on the company's payroll. Seven plants are located in Kansas City, Oklahoma City, Tulsa, Ardmore, Edmonton, Blytheville, and Odessa. Management of the company is young and progressive, yet long in experience; six of the executive officers are between 35 and 45, four between 45 and 55, and one over 60.

Products of the company have been well accepted throughout the gas industry for many years. BS&B was principally a tank company in the beginning. Now the many products available include the Free-O-Freez units for cold weather production problems; Uniflux units for high temperature process heaters; Dry Frac units for short cycle dry desiccant dehydrators; Cold Frac units for low temperature separation; and Dew Drop dehydrators for high dewpoint depression. Also high on the list of production are Phanto-Gagers and other lease automation equipment, Poxyglas filament-wound glass fiber products, and a complete line of controls, valves, regulators, safety heads and other units popular in the allied oil industry and pipeline field.

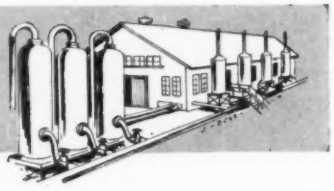
QUALITY CONTROL IS NO ACCIDENT

In talking with A. D. Kinser, works manager at BS&B's Oklahoma City plant, we found that the high quality products so identified with BS&B are no accident.

"You can't build quality into inspection," Mr. Kinser said as he stressed that quality was the result of hard work and perseverence. BS&B holds training schools for its employees on blueprint reading, welding techniques and other phases of the work to enable its people to do a better job.

An indication of the quality control may be gleaned from the presence of Jim Craig, of Ocean Accident Guaranty Corp. and a veteran of over fifty years of inspection service, who applies the ASME Pressure Vessel and National Board stamps to each product leaving the company's Oklahoma City plant. All vessels requiring the code stamp are manufactured in BS&B's Oklahoma City location. The latest in testing equipment is available to insure the highest quality product for BS&B customers—gamma ray and X-ray facilities—also latest techniques in testing are used by the staff of 12 in the quality inspection crew. ■

GAS PIPELINE NEWS



Nearly 42 million lb of coating on PG&E line

Nearly 42 million lb of asphaltic coating are being used to protect the 910-mile United States segment of Pacific Gas & Electric's line from Alberta, Canada, to the San Francisco Bay area.

The extremes in climate, terrain, and soil conditions make the pipe-wrapping operation an item of major importance. Altitudes range from 43 ft below sea level to 7000 ft above; tempreatures range from 115 deg above zero to 55 deg below. The pipeline crosses the Canadian Rockies, the Cascade mountains, and 14 major rivers, plus deserts, rolling wheatlands, precipitous canyons, dense forests, and rock lava beds.

Wrapping consists of compounded glass-fiber and felt outerwrap. Wrapping operations were handled by automatic equipment set up at 11 railhead pipeyards along the route (see photo).

In all, 20,890 tons of asphaltic coating was used for the 614 miles of Pacific Gas Transmission line located in Idaho, Washington, and Oregon. For PG&E's 296-mile California section, the contractor used Somastic coating compounded from a special fibrous filler, graded aggregate, and asphalt provided by the American Bitumuls & Asphalt Co., Standard Oil of California subsidiary. From the California border north to Canada, the contractor used a modification of the same company's Petrolastic Asphalt T-135. These coatings are compounded from an air-blown petroleum asphalt to which an inert mineral reinforcing filler has been added. The mineral filler is an amorphous type (non-crystalline with random size and shape), unaffected by dilute acids or alkalis, and is non-water soluble.

15-cent initial price set for Utah gas

Four independent producers were authorized to sell natural gas from Red Wash field in northeastern Utah conditioned on an initial price of 15 cents/Mcf.

El Paso Natural Gas Co. buys the gas from Standard Oil Co. of California, Gulf Oil Corp., Dorsey Buttram, and George P. Caulkins Jr. The gas is currently being delivered under temporary authorization granted Standard in 1960. That authorization was conditioned upon the reduction of the initial contract price from 18.5 cents at 15.025 psia pressure to 15 cents at the same pressure.

FPC presiding examiner Robert M. Weston said the courts have directed FPC to hold the price line on initial gas sales while more solid methods of price control are being worked out. The commission clarified the problem of the correct approach to the price line by establishing area rate levels, he said. Presumably, he continued, these initial prices will at some future time be set on the basis of the reasonable financial requirements of the industry and at levels adequate to maintain the gas supplies needed by consumers but no higher than necessary to accomplish these purposes.

For the time being, Weston said, the commission—lacking more exact standards—finds the correct price for a given new gas on the basis of the existing finally certified prices for other supply in the general area.

FPC accepts Panhandle allocation

On a temporary basis, FPC has accepted a revised winter allocation plan of Panhandle Eastern Pipe Line Co. and Trunkline Gas Co. FPC, however, ordered a different allocation for non-winter months.

Under the revision, Trunkline will deliver 24 MMcfd to Consumers Power Co., Jackson, Mich.; Panhandle would deliver 101 MMcfd to its customers. Included in the Panhandle volumes is 8 MMcf which FPC earlier reserved for possible service to 14 Illinois and Kansas communities seeking supplies from either company. Pending final action on the certificate applications, this 8 MMcf is to be sold to Michigan Consolidated Gas Co.

Tidewater's 15 rate hikes turned down

Examiner Joseph Zwerdling's decision in the Tidewater Oil Co. rate case is the second major natural gas producer rate case since the Supreme Court's Phillips decision in 1954.

Examiner Zwerdling denied 15 rate increases totaling about $2.8 million yearly. Using the cost-of-service method approved by FPC in the Phillips case, Examiner Zwerdling derived a unit cost-of-service for the test year 1957 of 11.45 cents per thousand. Using this rate, he found that Tidewater's jurisdictional revenues for 1957 were excessive by some $2.1 million. Tidewater, using its own cost-of-service method, had claimed a unit cost of 35.72 cents.

Zwerdling also terminated an investigation into the rates charged by Tidewater for all of its jurisdictional gas sales. He said that in view of FPC's expressed policy to fix producer rates on an area basis rather than on an individual company basis, the determination of Tidewater's future rates will have to await establishment by FPC of rates for the producing areas in which Tidewater operates.

FPC hears El Paso's Northwest plan

On Nov. 21 hearings will begin on a proposal by El Paso Natural Gas Co. to deliver additional natural gas for resale in Portland, Salem, Eugene, Albany, and Springfield, Ore.

Last February, FPC granted El Paso temporary authority to construct and operate about 121.4 miles of 10- to 20-in. laterals extending southward from its existing 26-in. mainline in Cowlitz county, Wash., across the Columbia river to the vicinity of Eugene.

Through these facilities, El Paso will deliver the additional gas to Northwest Natural Gas Co., Portland, for resale in the Oregon cities.

In the project's third operational year, the additional volumes of natural gas will total over 13 billion cu ft, of which an estimated 69.3 MMcf will be delivered on the peak day.

United Pipe Line plans loops

FPC has accepted four applications from United Gas Pipe Line Co. proposing construction facilities costing about $6.5 million.

One application covers 40 miles of 24-in. loops on United's existing Mobile, Ala.-Pensacola, Fla. line at a cost of $3.9 million. The facilities would be used to deliver about 49.8 additional cu ft of natural gas daily to existing direct industrial and resale customers in the Mobile-Pensacola area.

United also proposed to construct 10 miles of 30-in. loops in Terrebonne and Assumption parishes, La., as a cost of $1.9 million. The loops would make available the major increase in reserves and deliverabilities which have been developed in the fields presently connected to United's Turtle Bayou lateral and its extensions.

The other two filings were budget-type applications.

Well cleaning study issued

According to a new study published by AGA, increasing numbers of gasmen are using a foaming agent not too dissimilar to the detergent used for a family laundry, to "clean" gas wells.

A well in Texas county, Okla., which regularly became waterlogged, previously needed two weeks to free it of salt water. In a test conducted as a part of the study, foam treatment cleaned the well in two days.

The study (Catalog No. 36/PR), conducted by the U. S. Bureau of Mines in cooperation with AGA and the State of Oklahoma, is available from AGA for $2 per copy.

PG&E builds gathering line

Pacific Gas & Electric Co., San Francisco, is installing 44 miles of pipelines to connect new natural gas wells in Sutter and Colusa counties.

Lines vary in size from 3 to 20 in. in diameter. The gathering system's mainline will begin in Sutter county, run southwest to connect to PG&E's existing 20-in. Westside line near Dunnigan. A dozen laterals of varying lengths and diameters will join wells to a system along the route.

FPC streamlines organization

Several changes have been made at FPC to speed up its natural gas regulatory work. Included are the following:

Transferred all electric rate regulatory functions from the former Bureau of Rates and Gas Certificates into the Bureau of Power.

Changed the designation of the Bureau of Rates and Gas Certificates to Bureau of Natural Gas.

The new Bureau of Natural Gas will give its undivided attention to dealing with the mounting backlog of natural gas pipeline and independent producer rate filings and rate cases.

"Pipeline in the sky" gets protective coating

What is believed to be the highest natural gas pipeline in the U.S. will have nearly 1.5 million sq ft of pipe surface protected by Polyken pipeline coating.

Western Slope Gas Co., Denver, is building a gas gathering system in the Ute Reservation near Ignacio, Colo., and a 6- and 8-in. transmission line to Antonio, Colo. This line travels over the Continental Divide through Summit Pass and down into the San Luis valley.

Construction through the extremely mountainous country reaches an elevation of 12,000 ft at one point.

Contracts let

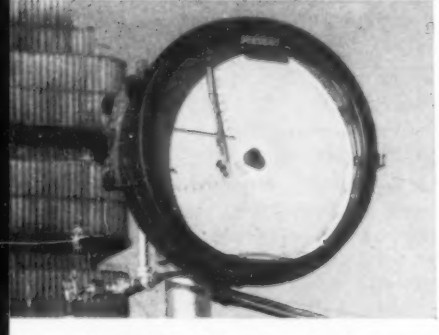
Natural Gas Pipeline Co. of America has let contracts for its latest expansion project, designed to boost its daily system sales capacity by 60 MMcf.

Panama-Williams Corp., Houston; Williams Bros. Co., Tulsa; and R. H. Fulton & Co., Lubbock, are working on the project.

Continued on page 140

Remarkable performance record — Foxboro T/37 meter operates 28 months without maintenance on corrosive sour gas. Mr. K. A. Sorenson, superintendent at Shell Oil Co.'s Bryan Gas Plant, Skellytown, Texas, checks the reading.

28 months on sour gas - and not a minute's maintenance for Foxboro's T/37 "dry" meter!



Unmatched stability in a dry flow meter! No zero drift. Complete overrange protection. Foxboro T/37 meter with unique Type 316 stainless steel high-sensitivity element, provides high-accuracy, mercuryless flow measurement over wide range of differential pressures and static pressures up to 2500 psi.

A Foxboro T/37 "dry" meter has just completed a 28-month continuous service test on sour gas at Shell Oil Co.'s Bryan Gas Plant, Skellytown, Texas.

During the test period, the meter required absolutely no maintenance. A complete inspection at the end of the test showed the meter was still as good as new. Not a sign of corrosion, wear, or pitting. And absolutely no zero shift under ambient temperature and pressure tests.

Moreover, a calibration check proved the T/37 to be well within the guaranteed accuracy of ¼ of 1%.

As Mr. K. A. Sorenson, superintendent of the gas plant, puts it: "We find the T/37 dry meter ideal for this service. Performance is excellent, and highly accurate."

The T/37 is a meter you should know more about! Ask your local Foxboro Field Engineer for complete details. Or write for Bulletin 7-15A. The Foxboro Company, 3411 Norfolk St., Foxboro, Massachusetts.

FOXBORO

REG. U.S. PAT. OFF.

By KEN KRIDNER • Engineering Editor

Is there a difference in being efficient?

AS I roamed the corridors of the Shamrock Hilton hotel in Houston at the recent annual meeting of INGAA, I had the opportunity to meet and talk with many persons responsible for the growth of automation in the gas industry. People not only from the transmission companies but also from companies concerned with the design and construction of such facilities. Since M-A-C is concerned with the introduction of automatic control equipment and the concept of automation into the operations of gas distribution and transmission companies, such an opportunity was not left unattended.

In line with this subject, Chairman Joseph Swidler of the Federal Power Commission delivered his now oft-quoted speech before the assembled group. Since Chairman Swidler is an appointee of President Kennedy and a representative of the Democrat's New Frontier party and partly because of his TVA background, many members of the gas industry looked with concern to his initial statements on FPC policy. Chairman Swidler directed the principal portion of his talk to area pricing policy. To M-A-C, area pricing is left to the producers and rate-makers — but when Chairman Swidler took cognizance of efficiency in operations, M-A-C sat erect, trained his beak toward the source of sound and strained his flapping ears to detect the thought behind the spoken word. For Chairman Swidler said, and I quote, "Fixing area prices based on area-wide costs and conditions would allow the individual company that is more efficient to reap the benefits of its efficiency. But to allow the company that is less efficient or not so fortunate to have higher rates would, in my judgment, allow the producer to have their cake and eat it."

Though the chairman qualifies his remarks to producers and is talking about area prices, it is difficult for us to visualize any difference in allowing a company credit for efficient operations whether it is in the business of producing, transporting or some other allied activity in the handling of gas. Thus M-A-C reasoned, Chairman Swidler was stating openly for all to hear that a company operating for the public interest (and thus subject to the rulings of a regulatory agency) should strive for efficient operations. And conversely, a company that persisted in operating inefficiently, in the chairman's personal judgment, should not be allowed to enjoy benefits of greater returns given the efficient company. Certainly readers of this column can pick no quarrel with such a sound and constructive line of reasoning.

But in the press conference that followed Chairman Swidler's speech, M-A-C asked the chairman if his remarks concerning efficient operations as quoted on behalf of area pricing and producer activities might also be considered as applicable to a transmission company. The chairman beat a hasty retreat and stated that the comments presented in his talk before the INGAA group were intended to refer solely to area-pricing and that he had not spoken on transmission operations.

M-A-C trusts that after the chairman has had opportunity to review his thoughts on the subject, he will come to the conclusion that efficient operations should be accorded recognition regardless of where they are encountered in the handling of gas. That efficiency is to be sought after in all phases of activity as the means of achieving a greater unit output at a lesser unit cost. It is in the field of efficient operations that automatic control equipment—"automation"—excels, and in such performance assures the American consumer of a continuing and more perpetual supply of energy—gas in the home.

M-A-C wishes to join the many others in the gas industry who were most impressed with what Commissioner Swidler had to say and who were in agreement with his forthright approach and his intense desire to become associated with the problems of the industry. To Chairman Swidler, M-A-C would like to say, "Welcome aboard, Sir. Bon Voyage!"

On the subject of meter charts

WHILE in Tulsa last month walking along Fifth Street I had occasion to meet a very good friend from yesteryear when I was closely associated with gas measurement. (That is to say, gas measurement was the source of my bread and butter.) Our conversation turned to gas meter charts and in turn to recent decisions of several companies to adopt 31-day charts in lieu of 7- or 8-day.

Now this particular item to an outsider would be of little interest —an outsider is anyone other than a measurement man. But recalling the difficulties encountered when I first suggested the use of 8-day charts instead of 7-day, this subject brought out the worst in me. Without intending to trespass on the feelings of anyone or to cast disparaging remarks, I should like to discuss the subject.

Continued on page 130

From North Electric...

THE PIPE LINE AUTOMATION PACKAGE!

North Electric . . completely custom tailors its Paricode® pipe line automation control system to your precise requirements,

. . . designs, engineers and produces the control system most economical, reliable and efficient for your operation,

. . . approaches your particular problems with the experience and knowledge gained in over four decades of leadership in the field of remote supervisory control systems. More than 5,000 North Supervisory Control Systems are in operation today.

The North Electric Paricode system is specifically designed for the automation of oil and gas pipe line transmission industries. North's "packaged" Paricode System is the result of our three-step approach to automation and includes the design of controls for every phase of your pipe line operation . . . plus the supplying of equipment for:

Supervisory control	**Analog to digital conversion**
Engine sequencing	**Digital to analog conversion**
Local control computors	**Adjustable deviation detectors**
Digital telemetering systems	**Instrumentation schemes**
Data display and logging	**Integrated central control**

Only in North Electric is there the experienced capability of a single organization to design, engineer and produce to your exact requirements reliable, fail-safe systems for progressive or full automation of your pipe lines.

ELECTRONETICS DIVISION

NORTH ELECTRIC COMPANY

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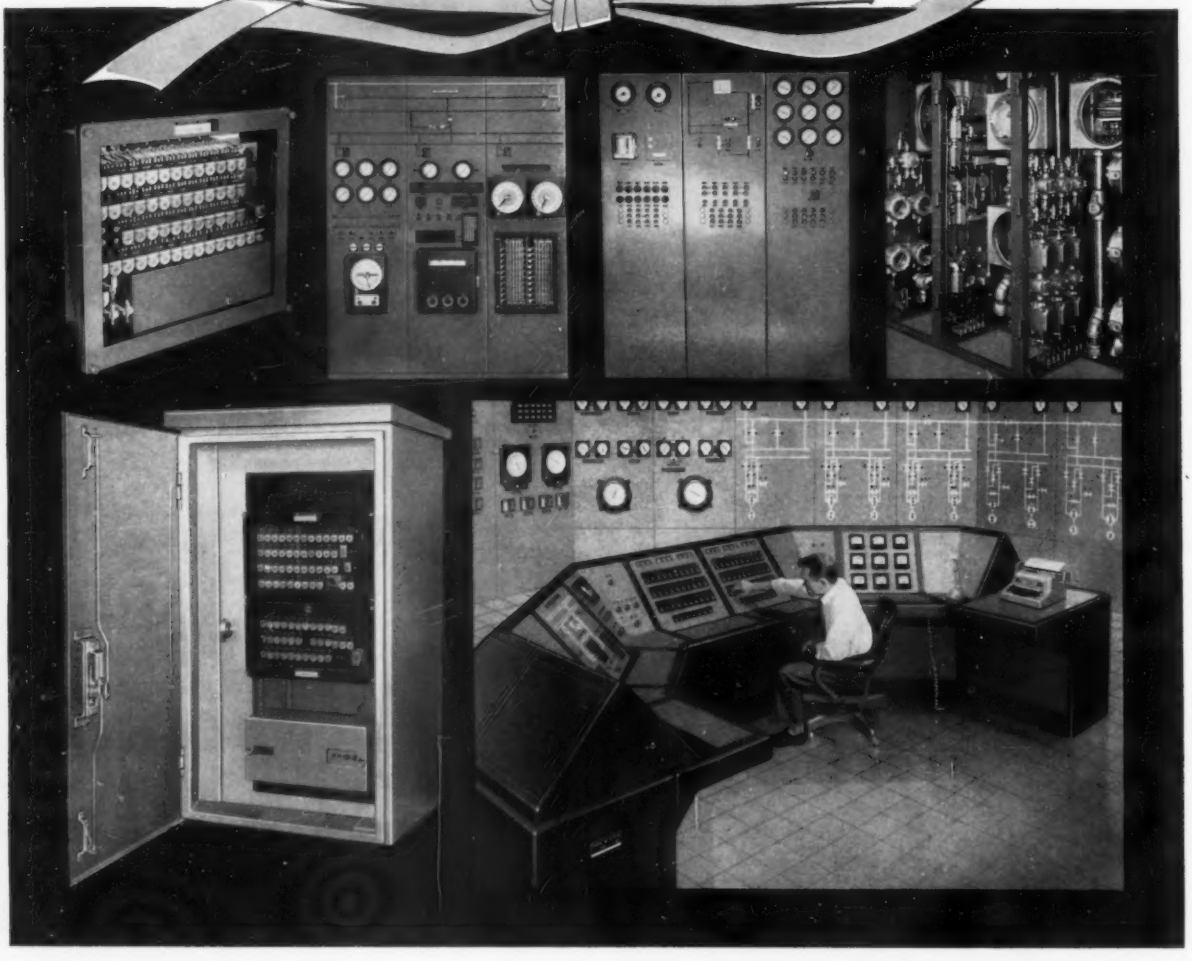
Represented by: Lynn McGuffy Company, Inc., Shreveport, La.



Communications Tele-Control

By F. VINTON LONG

Company-owned microwave—should we upgrade?

Plus some thoughts on private facilities vs. company-owned

QUITE a few of us have something to do with existing microwave systems, and, especially if they are of considerable age, there will come a time when we must think about bringing them up to date with modern equipment.

This is a pretty good investment in most cases because of heavy initial expense of roads and buildings, and towers, and engineering that has already been expended. So, a pretty good look at how system operation can be improved is certainly indicated. First, let's see just what does need improving.

We'll start off with access roads. I won't say much about them because there is not much we can do with them or about them once the system is installed. I'd say that we had better forget them and leave them as is.

Buildings come under the same category. We are usually stuck with them.

Heat control within the building is something else. I believe that with a modern system we should either have an air-conditioned building or none at all. So I would install air-conditioners as one of the first steps. It won't be too expensive, maybe $300 per site.

And from there I would turn to standby generators, if I used them, and most of us do.

If you don't go whole-hog and go to transistorized repeater equipment, then you probably won't need generators at all, and the joint will run with batteries.

If you don't do this, then the only answer is either a separate generator room in the building, or mount the thing outside. And, of course, you will run it on propane, and you will have a decent changeover panel; and don't forget the exercises so the thing will start when needed.

Now we come to antennas and feeder lines. These dipoles get old and must often be replaced, and that goes for coax lines, too, if we need them. We can sometimes do a lot of good by replacing even little bits of these things and pick up a few decibels at a time.

Now we get to some pretty important things that we can do if the RF paths are in pretty bad shape. Let's start in with fades.

Like taxes and marriage, that phenomenon is always with us. If we have an older system, we are probably not using dual RF equipment, and these fades can really fix us in the summer. The only reasonable cure is diversity reception, using either frequency or space diversity techniques.

The FCC in a recent meeting with some of us allowed that they wouldn't give us sufficient frequencies for frequency diversity. With this I do not necessarily agree, and I think that any honest individual trying to operate a pipeline could go to those gentlemen and obtain the frequencies he needs if he takes the time and is sufficiently emphatic.

The other way is space diversity, and if we add a receiver or two at each site, we will certainly help the cause. I would not bother with the transmitters.

Then if we have space diversity, and if we are unfortunate enough to have several stations in line and use the same frequency to transmit east and west per station, and we have overshoot troubles, then we can, with the diversity receivers, afford to split frequencies, even in the 2000 mc. band, and eliminate this trouble. (This is the type sentence that drives my secretary, Eva Sanders, crazy.)

Texas Eastern (TETCO) is considering this and Moe Sharp with Trunkline Gas, Houston, has it worked out whereby he may use his sidehop frequencies on the backbone and won't require brand new ones from the FCC. He or I will provide details on request.

So if we do the above, we should pretty well cure fade and overshoot troubles, mostly on 2000-mc. systems.

Then the question arises on whether or not we should junk the whole RF gear and buy new 1961 transistorized equipment, and use the standby generators mainly for tower lights.

There is quite a point to this and it should be carefully studied. Remember that all those resistors and capacitors and other gimmicks have been pretty thoroughly baked out by now, and, in addition, our old RF equipment probably won't have the future channel capacity that the 1961 models will have.

And the maintenance will be reduced to a fraction of the older stations. Using everything existing as is, it won't cost a fortune.

And if you want to shift from 2000 mc. to 6000 mc., you can have frequency diversity by using techniques employed by the New Jersey Parkway. (I will clue you in on this, if requested.) And if you do all that, in many cases you will not need dual equipment at all in those

Continued on page 132

M-A-C • Continued from page 127

When reviewing conventional versus direct-reading meter charts two months back, we mentioned that the circular disc in most common use was approximately 12 in. in diameter. Following the ancient code of the measurement man and operating all instruments between 20 and 80 per cent of full range, the circumference of the recorded line on the chart would vary between 14 and 25 in. in lineal length —regardless of the rotation cycle. It follows that if the chart makes a complete rotation each day, these figures represent the length of record on the chart. If the rotation cycle is 7-day, each day's record would be represented by one-seventh or if on 8-day, by one-eighth of the lineal length for a complete chart rotation.

Some years ago when the cost of labor was not so excessive, the number of men few, and good measurement personnel a scarce commodity on the market, the trend toward 7-day charts began. True, the accuracy of the individual measurement lowered but with the large number of meters and with evident inaccuracies on all sides, it was found that the error tended to cancel out and everyone was happy. The 7-day chart cycle was used mostly on field charts where delivery volumes were small, flowing temperature was often estimated, gravity was taken semi-annually or annually, and deviation factors were based on wide divisions of pressure and temperature. There were fewer charts to integrate and little consideration was given to the fact that the measurement record was being squeezed to one-seventh of its original length —most likely it would not have mattered anyway.

A few years back one of the manufacturers of clocks used in the orifice meters came out with an assembly whereby the rotation cycle of the chart could be changed with the transfer of the hub. Thus without the necessity for purchasing a new clock, the user could switch from 7-day to 8-day or 16-day by merely purchasing a new hub assembly at a very nominal cost. I for one could see a definite advantage to use of 8-day rotation — whereas, with 7-day there was a loss of four or more days of recording and the need for stacking up on charts at the end of the period—with 8-day chart, a 20 per cent decrease in handling could be enjoyed and the record condensed by only 10 per cent. True, at times it appeared that I was in the minority and certainly there are a number of people who are yet unconvinced as evidenced by their recent actions. Except for field chart-picking problems — principally scheduling — it worked out fine.

Now we see the advent of the 31-day chart. This would shrink the daily record to a space of between ½ to ¾ in. on the chart face. While it is very true that this decrease would not be detrimental if the delivery rate is constant, a fluctuating delivery would be difficult to detect and would result in an increased inaccuracy.

There are several factors that should be taken into consideration when considering the merits of the chart cycle. Gas proration, dispatching and accounting all depend on the accuracy of measurement. It was in the area of proration that I encountered the loudest and strongest protest to changing from 7- to 8-day charts. Even this 1-day delay apparently threw a wrench into the well-oiled machinery of persons responsible for accomplishing ratable takes among companies delivering into the system—and the delay was charged with hampering the task of personnel attempting to stay abreast of well production and status. Daily readings taken by meter jockeys though an assistance were too much in doubt to be relied upon. Dispatching though not as concerned with exact accuracy of measurement as accounting, leaned on the computed charts for up-dating their telemetered information.

Certainly I have for many years advocated the discontinuance of daily, 7-day, 8-day or 16-day chart grabbing—providing that the volume of gas passing is continuously telemetered to a central office under a scheme of automation that would see the system controller in close contact with every measuring device. In my mind, the function of measurement is one of overseer of what has taken place—to provide and assure accuracy of instruments for the measurement of gas flow activated by another department or company, and to verify the amount of gas passed. Thus as always, in my opinion, the measurement department policies the purse-strings of the company's income and payouts for gas.

It is in the realm of accuracy where I as a measurement man would seek assurance as to the validity of using 31-day charts. It has been stated that tests have proven measurement of gas using 31-day charts equalled and in some instances exceeded accuracy obtained from use of 7-day charts. I would look close at the basis for conducting and correlating data from these comparative tests.

Let's review the bellows meters

THERE was a circular distributed recently by one of the instrument manufacturers which stated that bellows meters compose better than 80 per cent of current orifice meter production. M-A-C has not been able to verify this figure but recognizes that since most large instrument companies are now producing a bellows-type instrument, there is little justification for doubting the accuracy of the estimate. There have been several companies, mostly production operations, that have indicated a desire to bring into the open problems of the bellows meter in the past—and to determine resolution of these problems. Everyone seeks a better understanding of the bellows unit in measurement today. M-A-C joins these companies in recognizing the challenge of bellows-type instruments in the field

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of measurement. There is a standing need for establishing a standard or norm for testing in order to yield maximum assurance to all parties concerned of the continuing accuracy of the bellows-unit in operation. We welcome the comments of users and manufacturers.

What about the meter situation?

THROUGH the assistance of this column, M-A-C seeks to enlist the efforts of measurement personnel of every organization in collecting data pertaining to orifice meters in use in the field today. We would like to ask these personnel throughout the country—in gas production, in gas handling, in gas transmission and in gas distribution — to submit the following type of information on their measuring instruments. In particular, M-A-C would like to determine the number of orifice meters in use—by manufacturer—by type, mercury or bellows—by pressure rating—by date of manufacture—and by service use.

We earnestly solicit your assistance on this project. Data may be mailed to M-A-C, Engineering Editor, GAS Magazine, 198 So. Alvarado St., Los Angeles 57, Calif. M-A-C's sincerest thanks.

Domestic meters also: To complete this picture of meter usage, the same type of data is sought from those companies in the distribution field on their domestic meters. In addition, we are most interested in determining the policies of distribution companies — large and small—as pertains to a testing schedule for the domestic meter. How often are such meters removed and proved, and what type of prover is used?

Is there a correlation normally observed between increasing system loss and meter inaccuracy? And are the small domestic meters temperature compensated?

M-A-C feels that gathering of this information and dispensing of the results to its readers through this column can be of inestimable value to the man in the field. ■

spots where diversity gear is not a necessity.

While on this subject, I firmly believe that a simple transistorized microwave system can be installed using batteries that will not have to be maintained. We could operate on the theory which my boss has amply pioneered with large single-unit compressor stations, that the blasted things will just not ever be shut down for troubles, or maintenance, and we should not throw in any equipment on a "just in case" basis.

And if someone has sufficient guts to try this in the communications field, I think he would be happily surprised.

And if we pursue this "needs no tinkering" philosophy, and if we use solid-state equipment, then we will eliminate lots of things, such as:

1. *Access Roads.* They won't be

Continued on page 138

LIFEBUOY — Symbol of protection against sea hazards

MIDWESTERN* — Symbol of protection against corrosion

Forces are changed but need for protection is the same

Midwestern's line of corrosion-resistant products offers you the most completely engineered protection in the pipe line industry. Successful performance under exacting field conditions has proven each product in the line.

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A Midwestern Man from one of our nine branch offices, located throughout the United States and Venezuela, is anxious to tell you about these protective products and to serve your corrosion needs quickly and efficiently.

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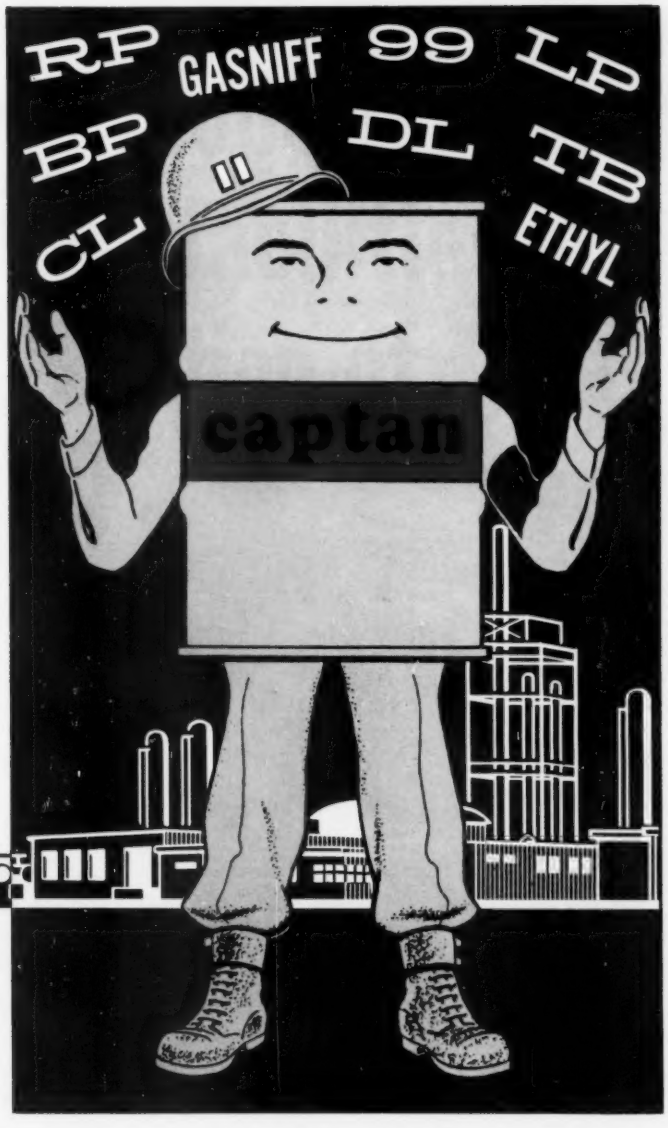

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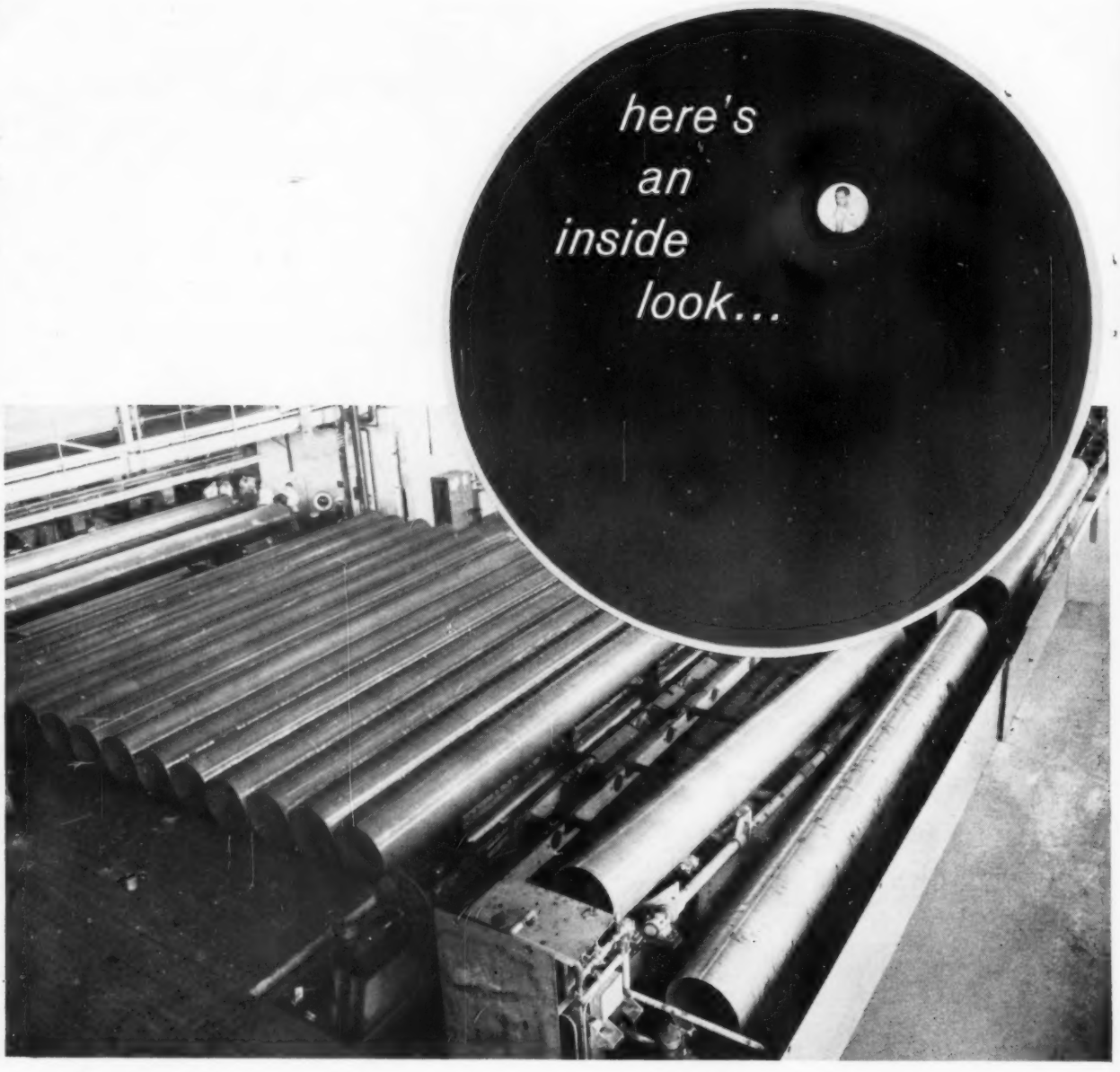

INSIDE STORY — Production line coating permits direct operation and supervision by A. O. Smith personnel, maximum automation and quality control and the protection of the already pickled internal surface of the pipe from adverse weather conditions.

Pipe coating equipment of a completely new design all under one roof! At Houston as well as Milwaukee you can take advantage of internal coating of 16″ through 36″ line pipe to your specifications — the complete automated process takes place in fully enclosed buildings supervised by expert A. O. Smith personnel.

And as in Milwaukee, equipment and operations have been specially designed to give particular attention to the cleaning and preparation of the pipe surface prior to actual coating. This follows A. O. Smith's belief that the best coating results are obtained from an originally clean, pickled surface, and that coating applied to such a surface will yield maximum benefits to the user.

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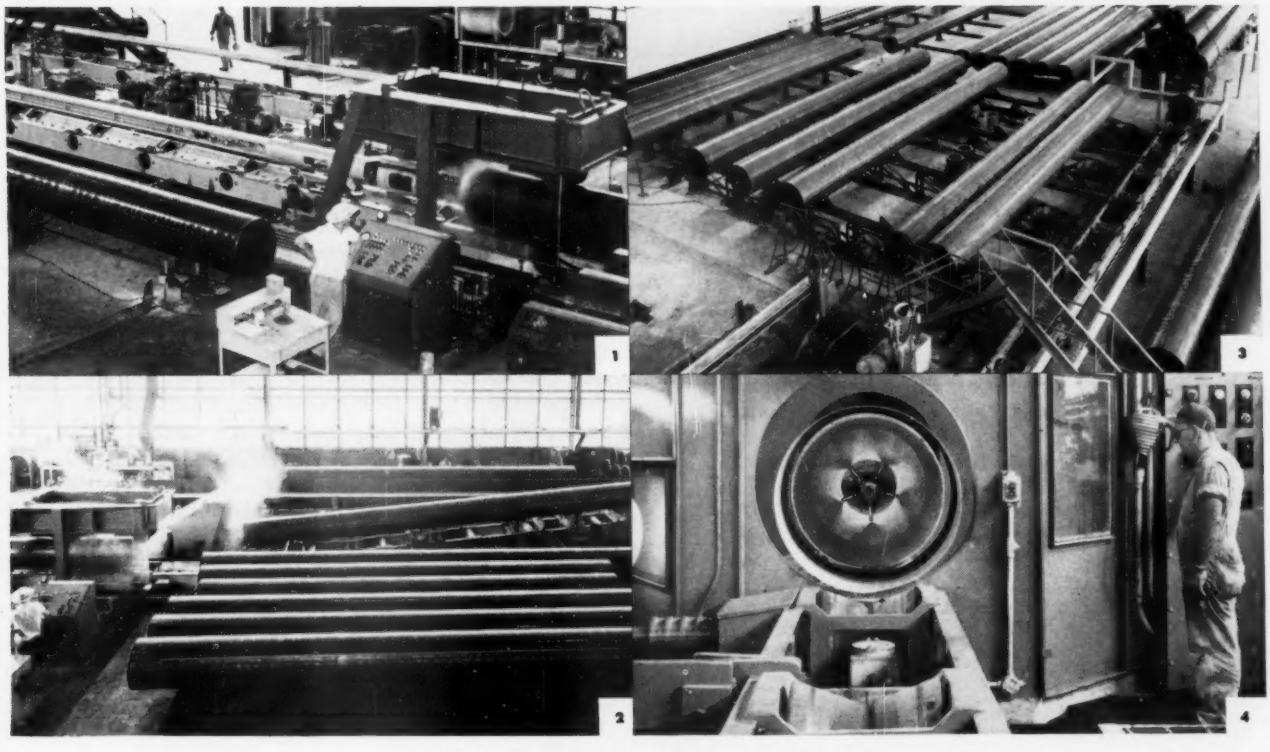

ALL UNDER ONE ROOF

1 DOUBLE SCRUBBING — Pipe is brushed on both forward and reverse cycles. On the forward cycle the pipe is wire brushed with a hot detergent solution. On the reverse cycle a clear hot water spray is used.

2 HOT RINSING — Water heated to 180° is used for the wash out operation. Pipe is elevated to drain rinse water while heated air is blown through to speed drainage and drying.

3 CONVEYING AND DRYING — After completion of the hot rinsing and wash out operation, the pipe dries as it is slowly conveyed to a holding station just outside the coating area.

4 COATING — Airless spray equipment applies the coating within an 8'x 8', dust-free steel enclosure. The entire coating area is separated from the rest of the mill by an "air curtain" created through pressure reduction.

Through research ...a better way

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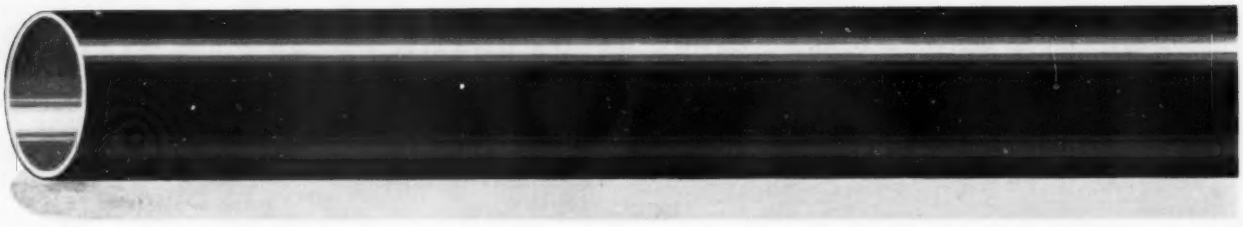
PIPE COATING MATERIALS

FROM PLASTICS DIVISION



PIPELINE PRIMERS

Fast-drying primers formulated to meet conditions normal to construction months. Always secure the maximum bond of the enamel to the pipe. In 55-gallon, non-returnable steel drums and 5-gallon pails.

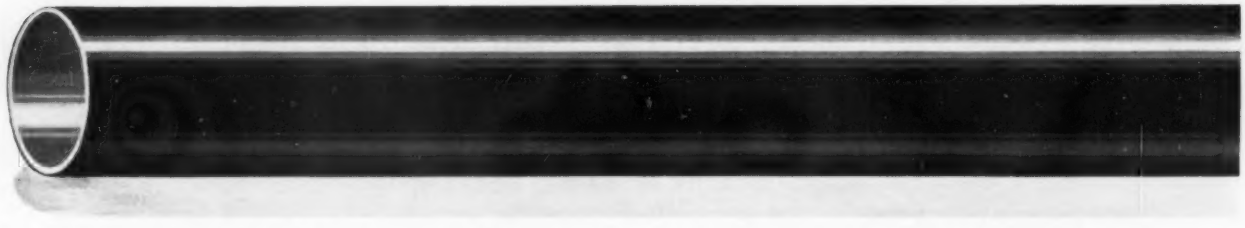
☐ **"Allied Chemical" Pipeline Primer #1190**—Constant quality service that keeps bond at interfaces of steel, primer, and enamel. Normal drying time six hours.

☐ **"Allied Chemical" Millwrap, #1300; 34YC, #1400; AA, #1500; Waterworks, #1600; Hotline, #1700 Primers** (Plasticized Primers)—Applied at low temperatures or at plants where temperature is controlled by ovens.

PIPELINE ENAMELS

Outstanding service records tell you that these enamels offer positively dependable and lasting protection. Easy-flowing coal-tar bases let you apply our enamels in less time and still be certain of a maximum bond.

☐ **"Allied Chemical" Waterworks Enamel #1600**—This enamel is a fully plasticized material produced to withstand the extreme temperature ranges of —20° to 160°F. Meets AWWA-C203-57 and AWWA-D102-55T, Sec. 5.4.4. specifications for both extreme coating and for interior lining of steel water pipe.



☐ **"Allied Chemical" Pipeline Enamel #1180, #1190 & #1200**—These enamels are highly resistant to soil stress effects. High in electrical insulating value! Non-absorptive, economical. Time-tested!

☐ **"Allied Chemical" Millwrap Enamel #1600**—Particularly suited for pipe in distribution systems, gathering and recycling work, mine supply and plumbers' supply, as well as dealers' stock. Supplied in metal drums weighing approximately 650 pounds each.

☐ **"Allied Chemical" AA Enamel #1500**—The all-year enamel! Plasticized enamel for external use only.

☐ **"Allied Chemical" Hotline Enamel #1700**—A special, fully plasticized enamel having extremely high resistance to high temperatures and soil stress. Has the service temperature range from 0° to 180°F. It will not slide or move off pipe at 200°F., under actual conditions found in underground service. It is an ideal coating where operating temperatures of the lines are high, or for lines in soil exhibiting high soil stress, and in places where there is rough, stony backfill.

☐ **"Allied Chemical" Enamel Flux #1000**—Use with narrow-range enamels when atmospheric temperatures are low and the coated pipe is exposed above the ground. Used correctly, flux will prevent checking of enamel.

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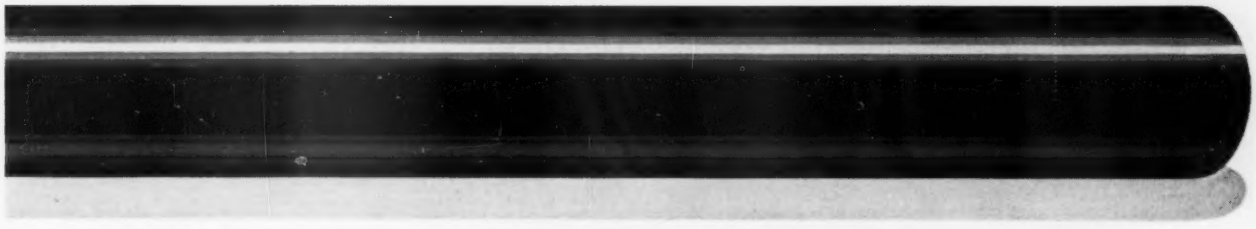
These are the same protective products you have known for years under the name "Barrett." Now they are brought to you by the Plastics Division.

Of course they are the same dependable materials manufactured from highest quality, refined coal-tar bases. The same superlative corrosion controls that always shield your pipeline investments. Notice that we have assigned new numbers to our pipe coating materials—to help you keep up-to-date on our growing product family.

Check the Pipeline Coating Materials you need and order now from Plastics Division.



AUXILIARY PROTECTIVE SERVICE MATERIALS

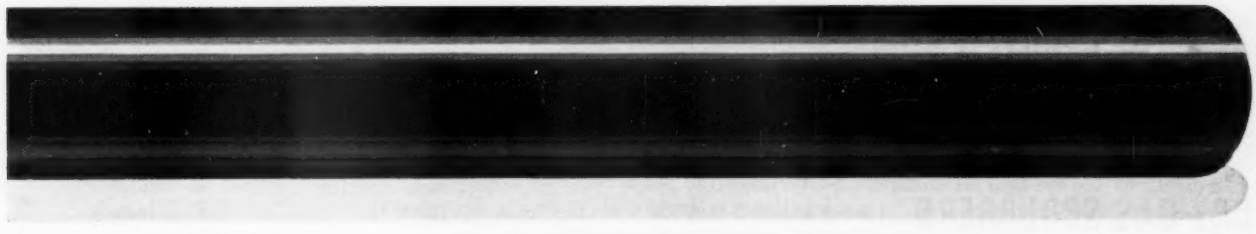
"Allied Chemical" Asbestos Pipeline Felts, plain or perforated, standard weight (regular or glass-reinforced), and glass-reinforced light-weight provide a protective membrane of coal-tar saturated asbestos that cannot rot or decay as a wrapper, shield, and reinforcement. They act as an enduring barrier to shield the pipeline enamels from earth loads and soil stress. They bond readily to all coal-tar enamels to provide an inorganic permanent shield and effectively assure economical, long-term protection against corrosion, mechanical or impact shocks, etc.

☐ **"Allied Chemical" Asbestos Pipeline Felt #1990**—Weighs approximately 15 pounds per 100 square feet. Impregnated with high-quality coal-tar saturant and bonds intimately with enamel. Unsurpassed shield against soil stress effects!

☐ **"Allied Chemical" Asbestos Pipeline Felt #1980**—(Light - weight Asbestos Felt)—Weighs approximately 8 pounds per 100 square feet. Impregnated with high-quality coal-tar saturant and glass-reinforced.

☐ **"Allied Chemical" Pipeline Fabric #161** — A strong, woven cotton cord fabric thoroughly saturated with high-grade coal-tar pitch. Tough, durable, flexible! Individual rolls 300 feet long.

☐ **"Allied Chemical" Service Cement #160** — High-grade, coal-tar pitch base, plastic materials for cold application and service work.



Order or specify to the yard-coating applicator the pipe coating materials you need to combat corrosion! You can't afford to speculate on protection.

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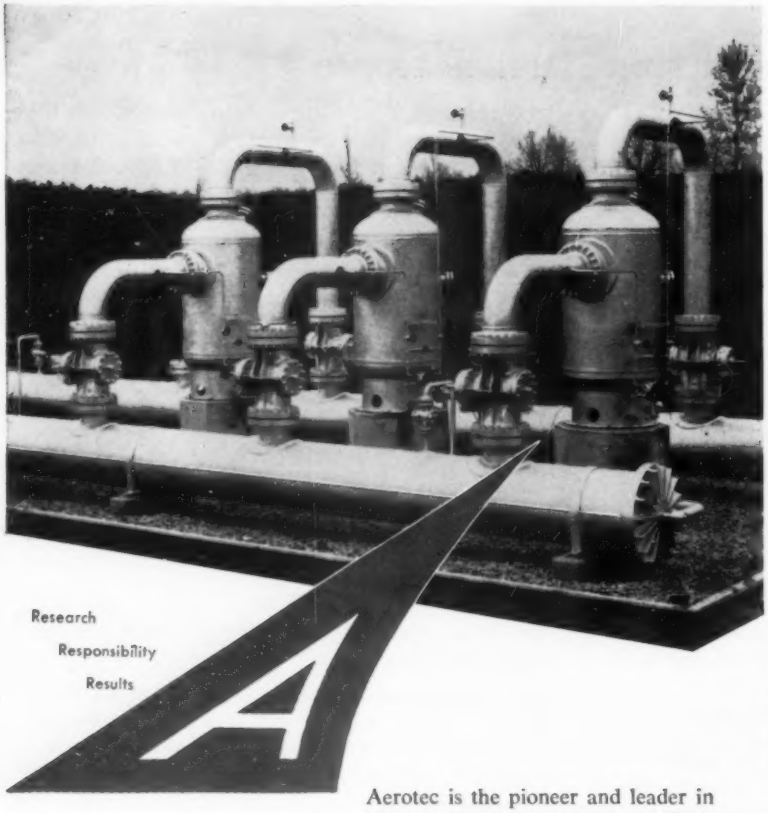

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Aerotec is the pioneer and leader in dry centrifugal gas scrubbers. Their units are world-renowned for constant pressure drop — no oil carry-over — high efficiency. Developed in close cooperation with the gas industry more than 17 years ago, the units' advantages stated above have been verified by the A.G.A. (Proj.NFX-12 Report).

Today, Aerotec dry centrifugal gas scrubbers are the focal point of attention by other manufacturers interested in centrifugal-type scrubbers. But the marked dependability and efficient operation of Aerotec units are the result of the more than 35 years experience in design and development of every type of centrifugal collector. This background and continued research is your assurance of trouble-free operation. Why not buy experience . . . it pays.

For Catalog AI-102 on Gas Scrubbers, write: Industrial Division, Aerotec Industries, Inc., Dept. G., Greenwich, Conn. In Canada: T. C. Chown Limited, Montreal, Toronto.

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COMMUNICATIONS
Continued from page 132

needed, because the maintenance man won't have to visit the sites but once a year or so, and at that time he can plug in whole new replacement modules of equipment. And he can hoof it instead of driving up that hill.

2. Buildings. Why needed?

3. Tower Lights. If you have to have them, hire a local tower watcher instead of installing electronic alarms.

4. Standby Generators. If you don't use them for tower lights, you don't need them at all.

5. Drop and Insert Service Channel. Why install if you aren't going to putter around talking, because there will be no maintenance. And if you need to talk, use your mobile VHF or the nearest phone.

6. All Standby Radio Equipment.

7. Steel Towers, If Short Ones. Use wooden poles and let the reflectors wiggle a little if they wish, because you won't lose your paths. Please believe this.

All this would provide you with a cheap and dirty system which would work.

So on upgrading your system you have two direct approaches, that is, either partially or whole-hog.

And now we may ask, "Why upgrade at all?", or, "Why fool around with our own microwave system at all?"

For a while, just last year, after the gas and oil people helped win the momentous FCC Docket No. 11866 and confirmed for us the freedom of choice of communications, the new offerings of the common carriers seemed to indicate that the days of the privately owned microwave systems were numbered. Suddenly, however, this picture seems to be changing rapidly, and the economic advantages of leasing communication services may not be as clear-cut as it seemed some months ago. This is due to a hassle over rates charged by the carriers, and this includes increases on private line offerings just ruled by the FCC. Also, management is now taking a second look to see if the advantages of a company-owned integrated system might not be worth, in possibly intangible values, some dollars in yearly outlays. ■

Trunkline waltzes through Vienna

The firing line welds multiple pipe joints for one of many road crossings.

That's Vienna, Illinois, a key point on Trunkline Gas Company's main line bringing natural gas from Texas and Louisiana to midwestern customers.

The snaking operation you see here took place in late spring of 1961, as Trunkline sped ahead with the construction of 154 miles of 30-in. x .361-in. main-line loops. Pipe for this 21-mile spread, extended north from Vienna, was supplied by Bethlehem Steel, and laid by Western Pipe Lines, Inc. We also furnished the pipe for Trunkline's 20-mile loop north of Oak Grove, Louisiana, where Panama-Williams, Inc., was contractor.

These days you can find Bethlehem High-Test Line Pipe on more spreads than ever before. That's because we recently expanded our output to meet the increasing demand for top-quality line pipe in diameters clear up to 42 in.!

Bethlehem Steel offers a full line of line pipe: From Sparrows Point, Md.—continuous buttweld from ½ through 4 in., nom., and electric resistance-weld from 5⁹⁄₁₆ through 16 in., OD. From Steelton, Pa.—electric fusion-weld from 18 through 42 in. OD. All Bethlehem line pipe meets appropriate API standards.

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BETHLEHEM STEEL

Northern proposes service to 65 more communities

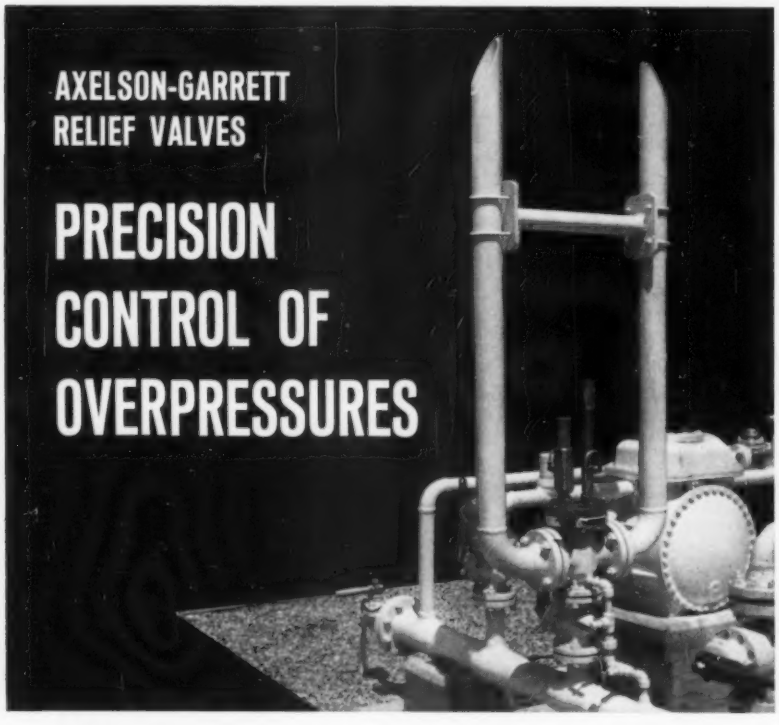
Northern Natural Gas Co. filed an application with FPC seeking approval of its plan to initiate natural gas service to 65 communities.

In its application, Northern plans to construct about 14 miles of 26-in. mainline loop east of its Waterloo, Iowa, compressor station, and 365 miles of branch lines ranging in size from 2 to 16 in.

Gas requirements of the communities (one in Nebraska, three in Iowa, 44 in Wisconsin, 17 in Minnesota) amount to 38 MMcfd. It will be supplied from Northern's underground storage field near Redfield, Iowa.

With the addition of the 65 towns in the 1962 program, Northern then would be serving 756 communities in the Northern Plains area.

Northern's 1961 construction program is nearing completion. It will add 169 communities to its system, including 103 in Iowa, 48 in Minnesota, 13 in South Dakota, four in Nebraska, and one in Illinois.



Why take chances on overpressure damage to lines and vessels when you can have positive protection with Axelson-Garrett Pressure Relief Valves.? Dependable and automatic, they relieve, blow down and reseat within extremely close limits . . . often within 1% of system operating pressure . . . available in operating range of 25 to 6,000 p.s.i.

Changing conditions are no problem either, as the controls can be set externally with exactness and will maintain accuracy of set and reset pressure over unlimited cycles, with no pressure accumulation. There is a bonus in maintenance savings, too . . . Axelson-Garrett Relief Valves do not "chatter" or "simmer" . . . fast, positive opening eliminates wear on valves and seats.

Check with your Axelson-Garrett representative or write direct on how you can add these economical safety valves to your installation . . . ask for bulletin #RV.

Products Designed To Give OIL A Lift

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DIVISION OF U. S. INDUSTRIES, INC. GENERAL OFFICES: LONGVIEW, TEXAS

Plans Washington storage

El Paso (Texas) Natural Gas Co. has asked Washington's Highway Commission for a permit to store 50 MMcf of gas in an underground dome in central Lewis county.

El Paso has obtained leases for the use of underground area from landowners in the region.

Northern offers stock

Northern Natural Gas Co., Omaha, has filed a registration statement with the SEC to issue and sell approximately 430,000 additional shares of common stock.

Proceeds from the sale will be applied toward the company's 1961 construction program, amounting to about $98 million.

20.5-cent price subject of hearing

Oral arguments will begin on Nov. 2 on Shell Oil Co.'s plan to sell natural gas from the Elk City field in Oklahoma at an initial price of 20.5 cents/Mcf. Buyer is Panhandle Eastern Pipe Line Co.

On July 11, FPC Presiding Examiner Robert M. Weston authorized the sale at the proposed initial price.

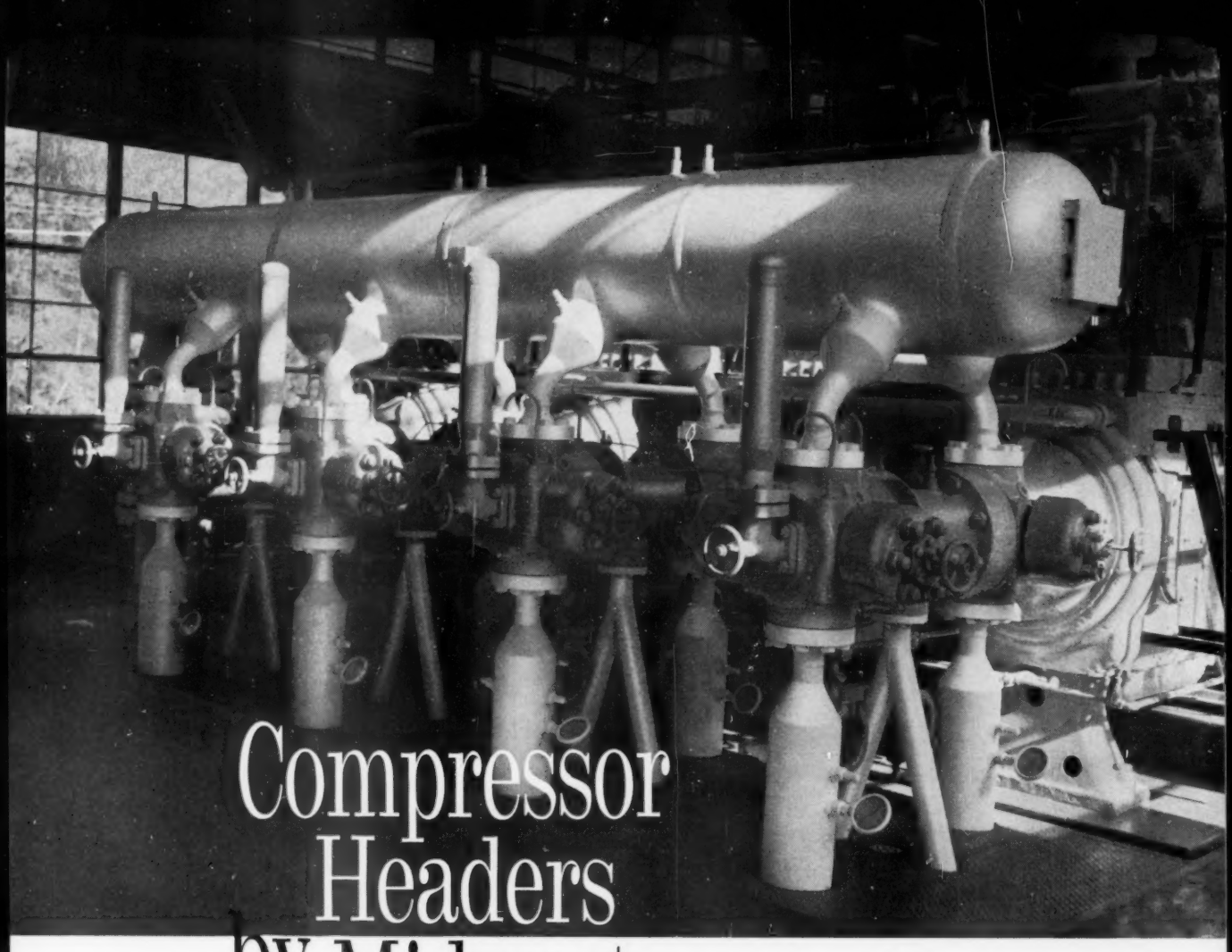
Exceptions were filed by the FPC staff. It had urged that the authorization be conditioned upon a 15-cent initial price to bring it in line with FPC price guides for that area.

Management course success

Representatives of 29 investor-owned gas and electric utilities attended Stone & Webster Service Corp.'s three-week management training course recently.

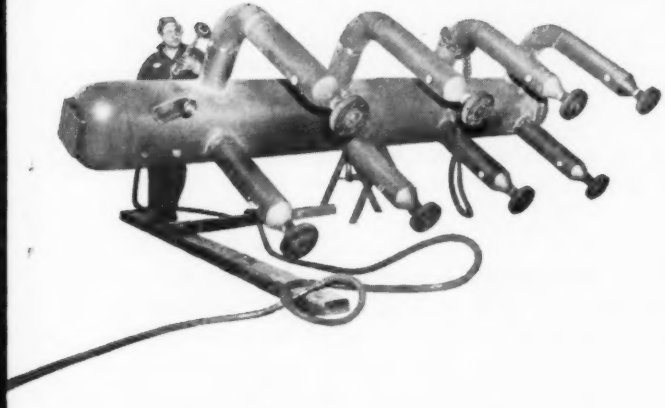
The 43 men represent the largest enrollment since the course began in 1933.

Virtually all fields of management responsibility and interest were covered, including labor relations, federal and state regulation, cost control, and the use of computers.



Compressor Headers by Midwest

Fabricated to your specification ...extruded or welded design...in any weldable metal



These compressor headers, fabricated for United Fuel Gas Company's compressor station at Coco, W. Va., are typical of the precision and quality of Midwest workmanship.

Upper header, formed of 24" O. D. x 1¾" thick rolled and welded Grade B carbon steel plate, has eight 8" extruded outlets reducing to 3" 1500 lb. flanged ends, and one 8" and one 3" full-size flanged outlets.

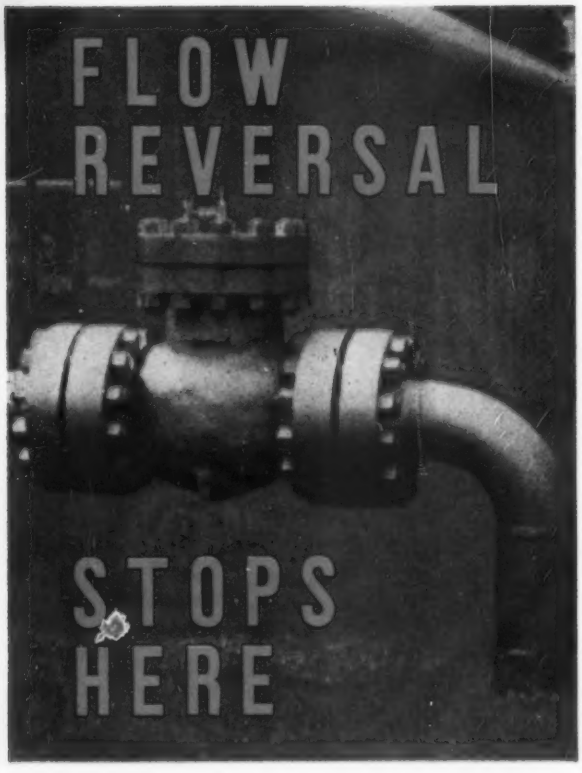
Lower header, of same diameter and wall thickness, contains eight 8" extruded outlets reducing to 3" 1500 lb. flanged ends, one 4" outlet, plus a 24" x 6" extruded cap.

This station, operating at 2000 lb. pressure, comprises five 880 HP and one 1100 HP gas engine compressors.

Midwest can produce headers to your exact specifications, in either welded or extruded type, and will gladly offer assistance on manufacturing and metallurgical problems.

New 36-page brochure, PIPELINE FITTINGS, describes Midwest fittings and fabricated piping for pipelines. FREE!

MIDWEST PIPING
A Division of Crane Co.
1450 South Second St., St. Louis 4, Mo.



Line back-surge is prevented by a positive, non-slam shut-off of the Daniel piston-controlled check valve. The "floating" piston rides well above the valve seat with line surges, eliminating chatter. Safely handles compressor and pump discharges, steam, gas and vapor flows.

A.S.A. pipeline, refinery and general use valves, 1" - 16", up to 6,000 p.s.i.g.

A.P.I. production flow line valves, 1" - 4", up to 10,000 p.s.i.g.

Send for Daniel Catalog Section "H".

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COMPANY

P. O. BOX 19097 • HOUSTON 24, TEXAS

Bigger withdrawals from Herscher sought

A peak-day withdrawal boost from underground storage is sought by Natural Gas Storage Co. of Illinois. Withdrawals from Herscher and Cooks Mills would be increased by 78 MMcf of gas to 833.

Mark V. Burlingame, executive vice president of the company, said that if the project is approved for 1962 construction, it will be the fourth consecutive annual expansion of this size.

The $3.3 million plan, filed with FPC, includes the drilling of additional wells and the installation of more compressor facilities at Herscher.

FPC to rehear Florida case

FPC will rehear its Aug. 9 order authorizing Houston Texas Gas & Oil Corp. and Coastal Transmission Corp. to expand their pipeline systems to bring additional gas to Florida.

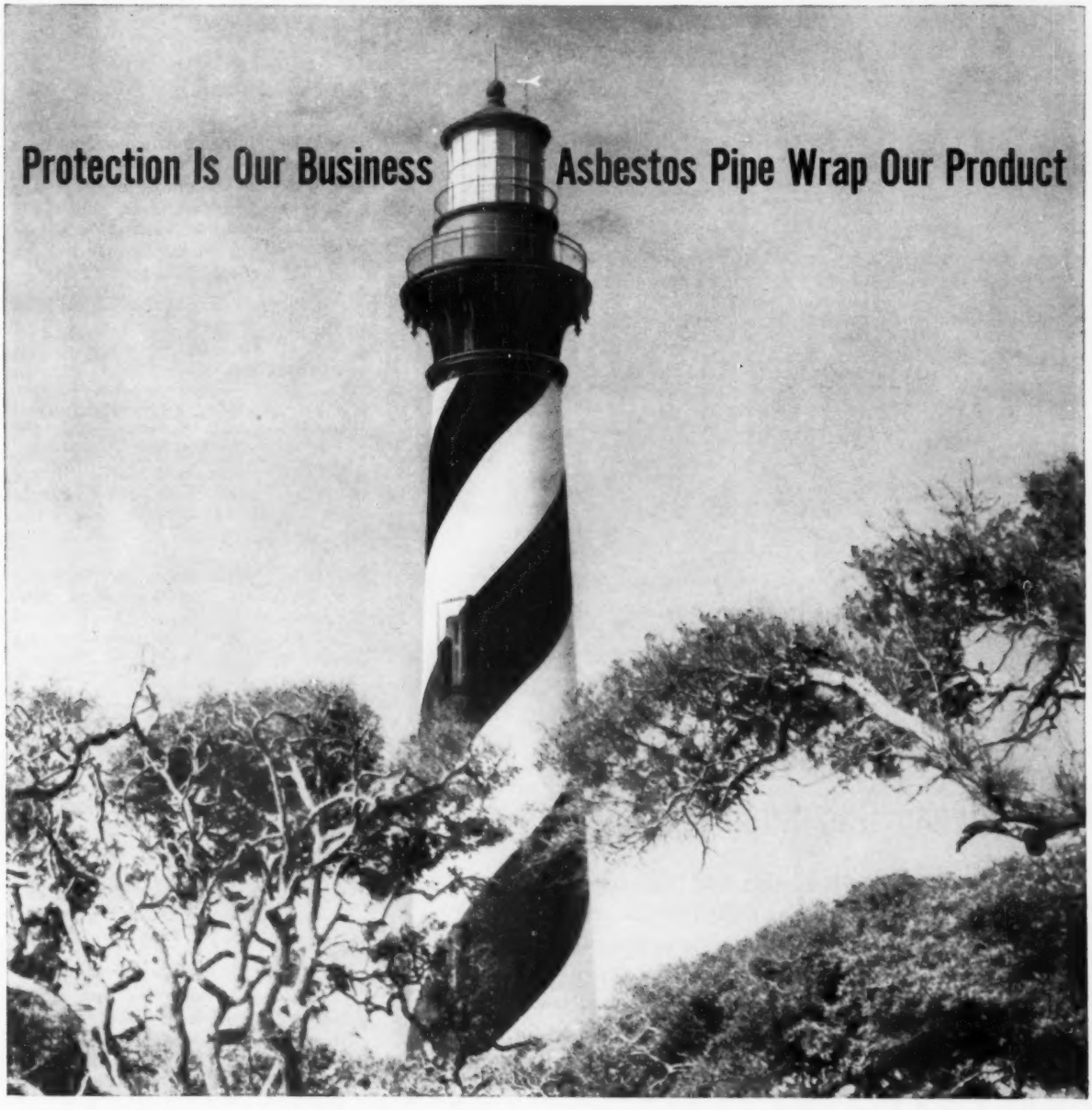
The Aug. 9 order approved applications by 53 producers to sell gas to Coastal, but only on the condition that their rates be collected subject to refunds of any amounts later determined to be excessive by FPC. The producers' proposed initial prices range from 13.5 cents/Mcf in Texas up to 23.5 cents in southern Louisiana.

At that time, FPC said it would be more appropriate to hold further proceedings on the producer price issue and in the meantime permit the producers to collect their full contract prices subject to refund. FPC did, however, condition the initial price proposed by two southern Louisiana producers of 23.25 cents instead of 23.55 cents to bring it in line with prices already certificated in the area.

Realignment approved

Manufacturers Light & Heat Co., Pittsburgh, can abandon its retail distribution and certain other Pennsylvania facilities by selling them to an affiliate, Columbia Gas of Pennsylvania Inc.

The realignment makes each operating subsidiary of the Columbia Gas System subject to regulation by only one regulatory agency.



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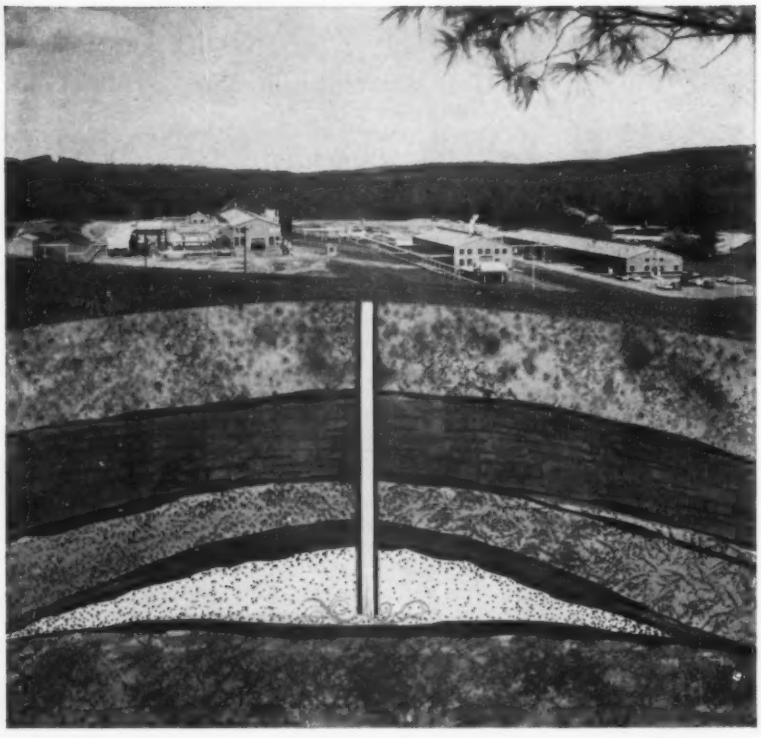


How Transco takes up the Slack Between Gas Supply & Consumption

Storing natural gas underground in depleted gas producing areas of Pennsylvania is an important part of Transco's business. The company's customers have large space heating loads in the winter which would be costly to serve if pipe line facilities had to be built between Texas and New York just for this purpose. Instead, Transco has developed for its customers a sort of "Christmas Club" whereby the customers authorize the company to store gas for their accounts in the low load periods of summer, delivering this gas in winter over short lines from the storage fields which are close to the metropolitan market area. Thus, while purchasing gas on a year-round basis, Transco, through underground storage, takes up the slack between supply and ultimate consumption of natural gas, effecting operational economies for both producers and marketers.

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

CARRYING NATURAL GAS FROM TEXAS AND LOUISIANA TO THE MARKETS WHERE THE MOST PEOPLE ARE.

FPC appoints

Ralph S. Spritzer, a career Justice Department attorney, has been named general counsel for FPC. Spritzer has been assistant to the Solicitor General since 1954.

He succeeds John C. Mason, who returns to his former post of deputy general counsel in FPC.

FPC has established a division of management assistance as a unit of its existing office of administration.

To provide more space and quicker access to customers, the Los Angeles offices of Clark Bros. Co. and Roots-Connersville Blower have been moved to 5915 E. Sheila St., Los Angeles 22, near the Santa Ana Freeway.

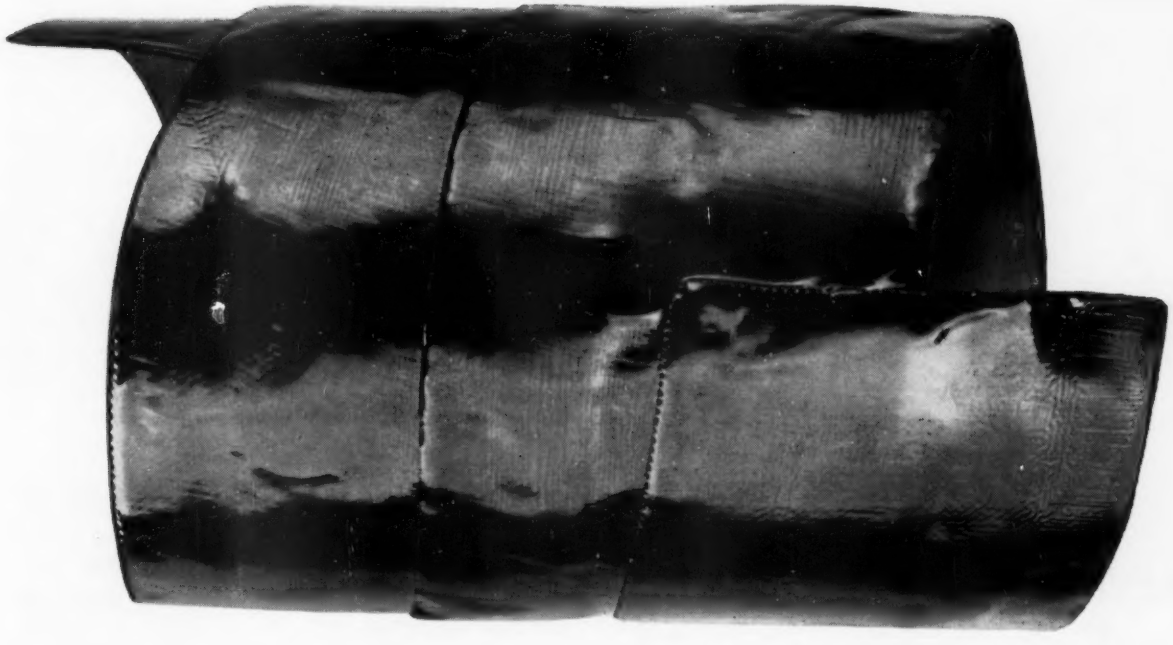
F. H. Maloney Co. has launched a $650,000 plant expansion program which will add about 48,000 sq ft—in two buildings—to its Houston facilities.

FPC hearings were slated to begin Oct. 27 to determine if favored-nation provisions in contracts between El Paso Natural Gas Co. and an independent producer were triggered by El Paso's contract renegotiations with other producers. Pan American Petroleum Corp. proposed increases in rate from 6.5 cents to 9.0 cents/Mcf for gas sold to El Paso in the Permiam Basin area. El Paso objected to the filing.

Southwest Industries Inc., Houston, is exclusive distributor for a line of turbocharger equipment made by the AiResearch Industrial division of the Garrett Corp.

A new Houston firm has been organized to sell, lease and service industrial communications equipment. Heading Electro-Lease Inc. is W. B. Campbell as president. The company will handle wired and wireless industrial communications systems and combinations of these for intra-plant and extended communications systems.

J-M Duratape® is the best protection you can find for pipeline joints and fittings



...either way you wrap it

Spiral or cigarette-wrap method, the job goes faster and easier with J-M Duratape. This wrap is exceptionally pliable, yet is strong and tough to resist tearing during application. And Duratape is a *complete* wrap; it needs no extra coating for reinforcement.

Duratape, developed especially for hot wrapping, is made of non-organic glass fibers, heavily coated with coal tar or asphalt enamels. It bonds tightly with the pipe, forming a continuous, integral surface that protects against electrolytic currents and other causes of steel pipe corrosion.

For the most protection per dollar, for enduring resistance to underground corrosive elements – always specify J-M Duratape Joint Wrap. And for complete information, see your J-M representative or write to Johns-Manville, Box 158, Dept. G-1161, N.Y.C. 16, N.Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.

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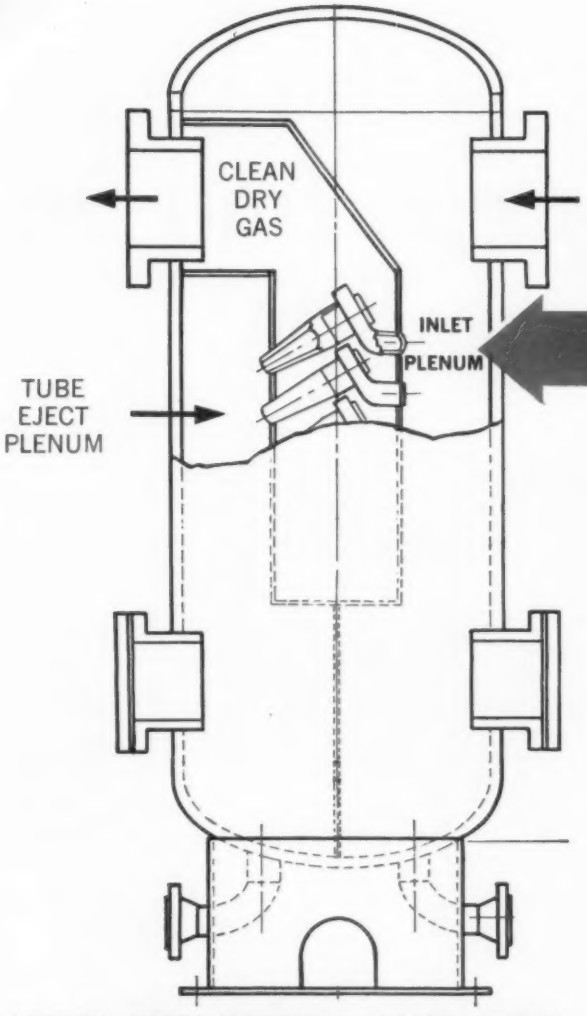


THIS MAKES THE DIFFERENCE

You don't find rabbits or lunch boxes in gas cleaners every day, but the type and variety of miscellaneous debris they collect is hard to believe.

In ordinary cleaners debris, slugs of dust, liquid and muck can plug or damage tube inlets or internals to rapidly decrease efficiency, increase pressure drop.

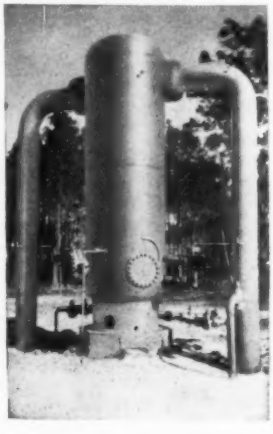
This cannot happen with a Blaw-Knox type D-LS Combination Dry Gas Scrubber and Liquid Separator. The miniature cyclone tubes are solidly welded into a tube sheet enclosure permitting clean and dry gas to be discharged into this separate compartment. As illustrated, this construction forms an inlet plenum on one side and a tube eject plenum on the opposite side.

An inlet plenum on this type of scrubber provides:

1. A primary separator where, by expansion, much of the dust, and/or liquid and debris drops into the reservoir before it can plug or damage the cyclone tubes.
2. Equal distribution of gas flow through the tubes.
3. Unobstructed gas inlet to the cyclone tubes.
4. Insurance of constant pressure drop.
5. Preservation of high efficiency.

There are other reasons why the Blaw-Knox D-LS Scrubber gives you clean, dry gas: abrasion-resistant, alloy cast iron cyclone tube design — sturdy, welded construction — high efficiency with low pressure drop, are a few. Write for Catalog 394 for all the facts—or ask our representative to call. Buflovak Equipment Division, 1547 Fillmore Ave., Buffalo 11, N.Y.

KEEP OUT DEBRIS LIKE THIS



This Blaw-Knox D-LS Combination Dry Gas Scrubber and Liquid Separator is installed at a town border station. Other applications are: **Compressor Stations,** on the suction side to remove solids and liquids and on the discharge side to remove carbon and condensed lube oil; **After Coolers or Condensers,** on the discharge side to remove entrained liquids and oil or water mist; **Compressor Stations, City Gate Stations and Large Industrials,** upstream from existing oil bath gas cleaner installations to remove condensate and prevent dilution of the scrubbing oil, and downstream to remove and recover entrained oil; **Dehydration Plants** as a combination unit to remove solids and liquids upstream, and downstream of the adsorption type plant to remove dust caused by attrition of the solid dessicant, and downstream of the absorption type to remove the entrained liquid dessicant.

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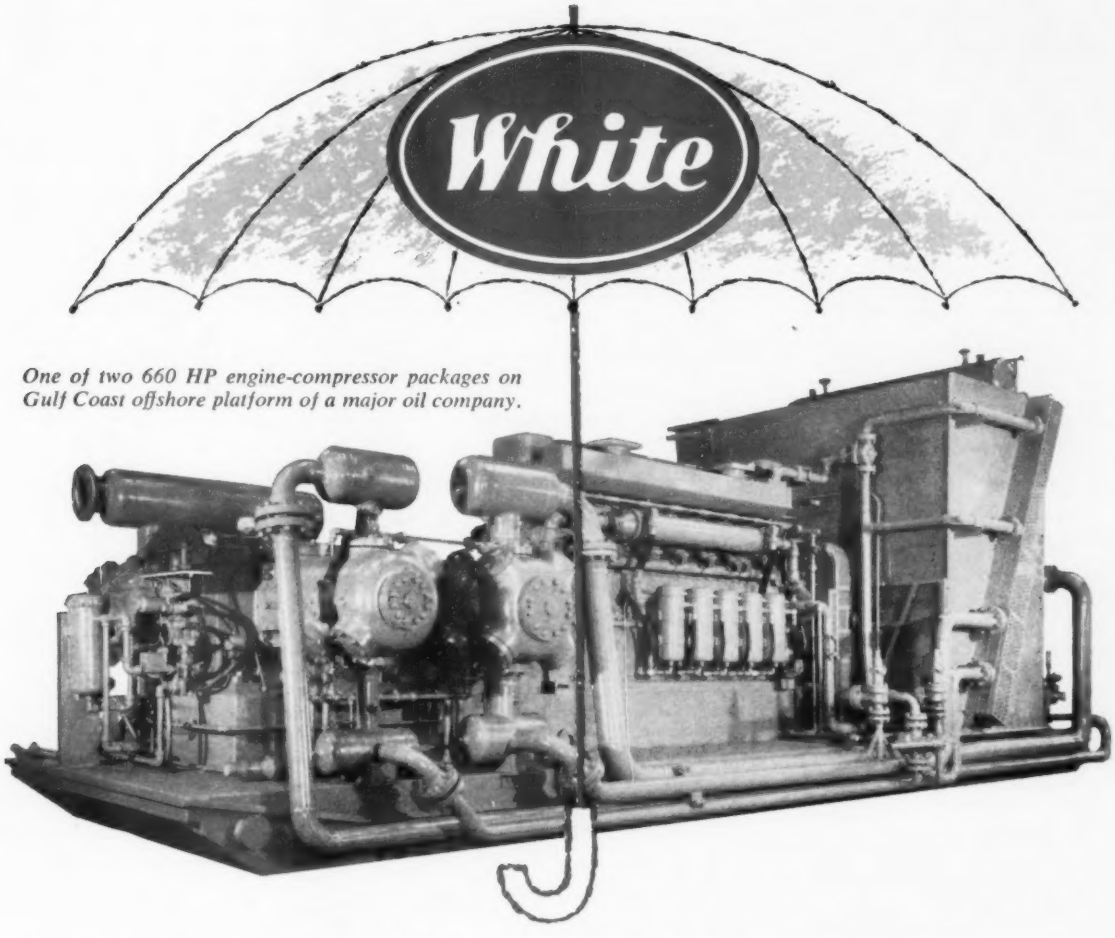

One of two 660 HP engine-compressor packages on Gulf Coast offshore platform of a major oil company.

White's single responsibility covers Engine and Compressor ALL THE WAY

White-Superior 200/1000 BHP Compressors are designed for exact match with Superior *medium speed* gas engines. Both units are precision built to identical standards at White in Springfield. White therefore assumes *complete and undivided responsibility* for all vital parts on its direct-driven, balanced opposed engine-compressor sets.

Single responsibility *all the way* starts with pre-engineering (selecting the right combination for your job) . . . extends through manufacturing, the installation alignment check-out and start-up. White also provides on-the-job training of your personnel for proper operation and maintenance of complete unit. You'll find factory service and parts readily available from White's extensive field service organization.

Two, four and six-cylinder, single or multi-service compressors are available properly packaged (see list) and ready for service. For engineering assistance or Bulletin 124, contact nearest White representative or write today to White Diesel Engine Division, Springfield, Ohio.

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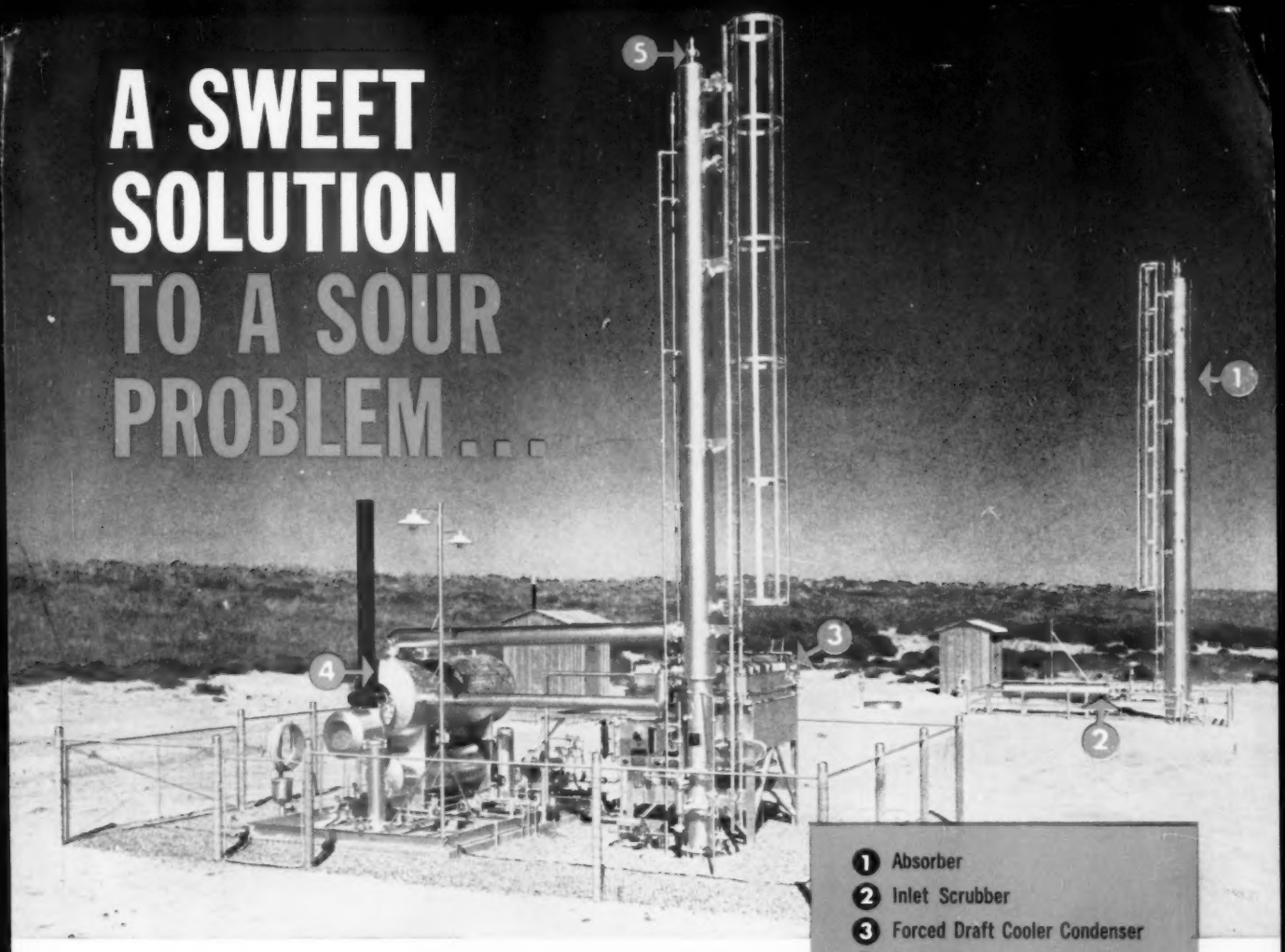

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Whatever your needs for domestic, commercial, or light industrial gas metering, Sprague has a meter to do the job. Each is designated by its capacity rating to make your selection easy. Each is available in either iron case or aluminum case†.

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